ENGLISH
NATURE

A review of the extent, conservation interest and management of lowland acid grassland in England

Volume I: Overview

No. 259 - English Nature Research Reports

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English Nature Research Reports

Number 259

A review of the extent, conservation interest and management of lowland acid grassland in England

Volume I

N.A. Sanderson
(Ecological Planning and Research)

ISSN 0967-876X
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Volume I

English Nature Contract VT2.1C

Commissioned from Ecological Planning & Research
129 Andover Road
Winchester
Hants SO22 6AY

Main Author
N.A. Sanderson BSc MSc

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Summary

1. The conservation of lowland acid grassland in England has not received as much attention in recent years as the conservation of neutral or calcareous grasslands. However, dry lowland acid grassland has been recognised as a key habitat in the Biodiversity Report for the UK and a Biodiversity Action Plan is due to be produced for it in 1998. The Plan will cover the National Vegetation Classification types of acid grassland that are mainly represented within the NVC communities U1 to U4. Improved knowledge of the habitat will be required to implement the Plan and English Nature therefore decided to commission a review of current knowledge on the extent of lowland acid grassland, its conservation interest and management and an assessment of any gaps in knowledge of the location and quality of remaining sites.

2. For the purposes of the review, acid grassland is defined floristically by reference to the NVC. The relationship of the main communities (U1 to U4) to other grassland and heath types is discussed as well as links with associated communities found in acid grassland landscapes, in particular inland sand dune (SD) communities and Bracken stands.

3. Comprehensive vegetation surveys of lowland acid grassland are lacking in England. Methods used to assess the current extent and distribution of the resource included examination of geology and soil maps, development of lists of plant species that could indicate the location and distribution of acid grassland, review of existing survey and Inventory information, and consultation with English Nature's Local Team staff and others in every EN Local Team area across England. Using this information, provisional estimates for the extent of component acid grassland communities are made for England as a whole and for each county. Likely totals are expressed as ranges within low, medium and high estimates. The total area of lowland dry acid grassland is suggested to be in the range 15,000 to 22,000 ha, with individual communities estimated as follows; 8,000 to 12,500 ha of U1; 3,000 to 5,500 ha of U2; 2,000 to 3,000 ha of U3; 3,000 to 5,000 ha of U4; 150 to 450 ha of inland SD10; 60 to 300 ha of inland SD11.

4. The nature conservation interest of the flora of acid grassland is considerable, and lowland acid grassland comprises a unique series of plant communities that make a significant contribution to the biodiversity of lowland England. The habitat has an undeserved reputation as being species-poor. In fact, the review shows that plant species richness per unit area in some stands equals or exceeds the richest lowland neutral and calcareous grasslands. Lowland acid grasslands, in particular U1, harbour a considerable number of rare and scarce vascular plants, including 17 nationally rare and 22 nationally scarce species. Maps of past and present distributions of species that are generally only found in acid grassland show that severe declines have occurred, resulting from habitat loss but also deterioration of habitat quality. Lack of management of remaining acid grasslands has led to the disappearance of species that depend on short, open grassland, even on protected sites such as National Nature Reserves. Acid grasslands are also significant for lower plants, of particular note is the lichen flora of U1 grasslands. There is growing recognition of the value of acid grassland, particularly U4, for fungi floras and this aspect of their nature conservation interest needs further investigation.

5. Lowland dry acid grassland shares a threatened bird fauna with dry calcicolous grassland. The habitat is of importance for a number of species of conservation concern (Red and Amber Lists), in particular, Stone Curlew and Woodlark. Declines in birds that require short turf have parallelled those for vascular plants and indicate the effect of lack of habitat management. Acid grassland forms part of habitat mosaics used by all widespread species of amphibians and reptiles and also is a component of habitats that are important for three rare species, Smooth Snake, Sand Lizard and Natterjack Toad. The invertebrate species assemblages of acid grassland have not been extensively studied but the habitat supports rare species such as

the Large Blue butterfly, and a number of specialist species. Acid grasslands can encompass significant amounts of bare ground, which are important for burrowing invertebrates.

6. Conservation of the nature conservation interest of acid grassland is largely dependent on the continuation or re-instatement of appropriate management. Grazing animals have a crucial role to play in conservation management and acid grassland forms an important part of forage for livestock in heathland habitat mosaics which are managed by extensive grazing. A landscape approach to habitat conservation will be needed if sustainable, extensive, pastoral systems are to be restored. The vital place of acid grassland in a functioning landscape of heathland and low-intensity arable farmland should be recognised and consideration given to the role of acid grassland in heathland re-creation and restoration schemes. Knowledge of the location of existing sites and past and present distributions of acid grassland flora as well as information on suitable soils can assist in defining potential areas for acid grassland re-creation, as demonstrated in the review.

7. Survey requirements fall into two main categories: first, locating remaining sites and assessing the type and extent of their acid grassland communities, in particular U1, and second, floristic assessment, which should include obtaining information on rare and scarce species. A provisional indicator species list is proposed to assist in the floristic evaluation of acid grasslands. Both types of audit are required to target conservation measures such as incentive schemes, and to prioritize action, as well as for monitoring conservation condition of grasslands and informing management decisions, for instance regarding appropriate grazing levels. Ten high priority areas for survey are identified in the review, plus 9 medium priority areas and 3 lower priority areas.

8. A provisional assessment of the relative importance of different areas of England for lowland acid grassland is presented as an interim measure before more comprehensive information on the resource becomes available. The assessment is based on the national and county information collected during the review and the results are described in relation to English Nature's Natural Areas. Classes used in the evaluation range from areas with very diverse and often extensive acid grasslands, where restoration at a landscape scale is particularly important, to areas with more fragmented acid grasslands of county importance and SSSI quality. The highest rated areas are: Breckland, the New Forest, Dungeness, the Dorset Heaths, the west Wealden Heaths, the south coast of Devon and Cornwall, the Sandlings and Suffolk coast, the Solent coast of Hampshire and the Isle of Wight, the Shropshire Hills (together with adjoining areas in Wales), and the Coversand Heaths of Lincolnshire and Nottinghamshire.

9. England has the bulk of the UK's lowland dry acid grassland resource although Wales has some outstandingly rich examples of U1-related stands. There is little readily available information on the European status of the habitat but in a European context the English resource appears to be very significant in terms of its extent.

1. Introduction

Semi-natural grassland within lowland England is a scarce and declining resource. This decline can largely be attributed to agricultural intensification although other factors such as neglect and scrub invasion, afforestation and increasing urbanisation have all had an impact.

As a result of these threats, conservation organisations have worked towards identifying and protecting the remaining semi-natural grasslands. The notification of SSSIs and acquisition of nature reserves has played an important part. In addition, important conservation mechanisms for protecting semi-natural grassland within the wider countryside are now available. The most significant wider countryside schemes are the Environmentally Sensitive Areas (ESA) scheme and the Countryside Stewardship Scheme (CSS), which provide incentive payments for the conservation management of semi-natural grasslands. However, to date, most attention has been focussed on calcareous and neutral semi-natural grasslands rather than acid grasslands, although in April 1996, the CSS was extended to cover all lowland acid grasslands. Relatively few surveys to locate and evaluate the nature conservation interest and management condition acid grasslands have been carried out. Conservation action has been correspondingly less, perhaps because their vascular plant component has been perceived as being less rich (though distinctive) when compared to calcareous or neutral grasslands.

A recent development has been the production of the Biodiversity Report for the UK (UK Steering Group 1995). Lowland acid grassland on dry soils is recognised as a key habitat in the Report and a Biodiversity Action Plan is due to be produced for it in 1998. Improved knowledge of the resource will be required to implement the Plan, for instance to target the CSS.

English Nature therefore decided to commission a review of current knowledge on the extent of dry lowland acid grassland, its conservation interest and management, and an assessment of any gaps in knowledge of the location and quality of remaining sites. In terms of the National Vegetation Classification the acid grassland types to be reviewed included U1 (Festuca ovina-Agrostis capillaris-Rumex acetosella grassland), U2 (Deschampsia flexuosa grassland), U3 (Agrostis curtsii grassland) and U4 (Festuca ovina-Agrostis capillaris-Galium saxatile grassland). These communities comprise the major part of BAP key habitat of lowland acid grassland.

The aims of the review were to:

- identify areas in England likely to have acid grassland
- assess the completeness of survey information
- make a provisional estimate of the extent of the total resource
- provide examples of the composition and management of acid grasslands
- review and summarize the conservation importance and management of acid grasslands
- provide an assessment of the priorities for botanical Phase 2 survey of defined geographical areas
- provide a provisional evaluation of the significance of acid grassland on a geographical basis and relate the resource to the UK and European context.

The review has largely involved a desk study of existing information and consultation with staff in Local and National Teams in English Nature, together with some staff from other organisations such as Wildlife Trusts. A limited amount of field survey of illustrative examples of acid grasslands was undertaken in 1997. Volume I of the review provides the general picture of the resource and Volume II gives a more detailed assessment of the resource across the counties and Natural Areas of England. Appendix I of Volume I contains the examples of acid grassland sites, described by extracts of published data and data from 1997 survey work. Further survey details for sites visited in 1997 have been sent to the relevant Local Team.

Nomenclature

The conventions used in the review for species names are as follows:

Plants

Vascular Plants: Latin names follow Stace, C. (1991), except for Latin names within plant community names, as published in the NVC, to avoid confusion over the identity of these communities. The alternative NVC names following Stace are given in Chapter 2, where the NVC communities are described.

Mosses: Latin names follow Corley and Hill (1981) except for the genus *Hypnum* which follows Smith (1997), and *Racomitrium elongatum* which follows Frisvoll (1983).

Liverworts: Latin names follow Smith (1990).

Lichens: Latin names follow Purvis *et al* (1994).

Animals

English names, except for invertebrates which have English and Latin names, the latter follow the Recorder dictionaries (Hawkswell and Marshall 1995).

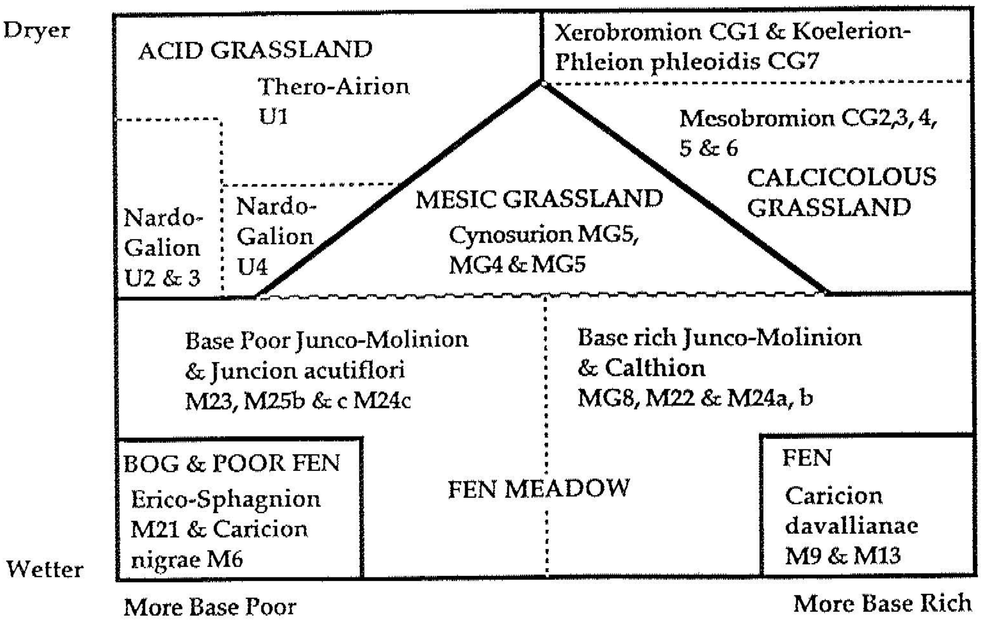
2. Definition of lowland acid grassland

2.1 Floristic definition, soil types and related vegetation

The definition of dry acid grassland adopted in this review is floristic, being based on the National Vegetation Classification (Rodwell 1992). The main communities which are included in the review (U1 to U4) are put under the umbrella term 'calcifugous' grassland by Rodwell (1992). 'Acid' grassland or 'calcifugous' (lime-hating) plants are associated with soils which have a chemical base status represented by a soil pH at some level below pH 7. However, 'neutral' grasslands also occur on soils with pHs of less than pH7, though these soils are usually more mildly acidic (nearer to pH7). There seems to be a lack of published information as yet on the soil pH and soil nutrient content of lowland acid grassland NVC communities. The measurement of soil pH is problematic but some examples which pre-date the NVC give an idea of characteristic levels. In Sherwood Forest, pH 4.3 was recorded for soil under *Deschampsia flexuosa* grassland (Marrs *et al* 1991). In south-west England, a record of pH 5.2 was made for soil under *Agrostis curtisii*-dominated grassland (Elmes and Wardlaw 1982a), and pHs ranging from 6.2 to 3.7 were recorded for soils of *Festuca-Agrostis* grasslands containing *Rumex acetosella* in Breckland grass heath (Watt 1940).

In terms of moisture status, dry acid grasslands are distinguished from wet communities in the NVC by Rodwell (1991) defining fen-meadow and rush-pasture (which incorporate wet acid grassland) as associated with soils that are moist for a substantial part of the year. However, the 'dry' acid grasslands themselves vary in moisture status from very dry U1 types to relatively moist U4 grasslands.

The relationship of dry acid grassland communities and other grassland communities to soil moisture and base status is shown in Fig 1. The diagram also includes the names of the Continental phytosociological affinities of these communities (Rodwell 1991, 1992).


Dryer
Wetter
ACID GRASSLAND
Thero-Airion
U1
Nardo-Galion U2 & 3
Nardo-Galion U4
Xerobromion CG1 & Koelerion-Phleion phleoidis CG7
Mesobromion CG2,3, 4, 5 & 6
CALCICOLOUS GRASSLAND
MESIC GRASSLAND
Cynosurion MG5, MG4 & MG5
Base Poor Junco-Molinion & Juncion acutiflori M23, M25b & c M24c
Base rich Junco-Molinion & Calthion MG8, M22 & M24a, b
BOG & POOR FEN
Erico-Sphagnion M21 & Caricion nigrae M6
FEN MEADOW
FEN
Caricion davallianae M9 & M13
More Base Poor
More Base Rich

Grasslands of stagnant gleyed soils (i.e. MG9-13) omitted.

Key:
——— Marked floristic discontinuity
- - - - Moderate floristic discontinuity
～～～ Diffuse floristic discontinuity

Figure 1 Soil base status and moisture content of lowland grassland communities

The published NVC volumes lack, as yet, an overall key to the formation types in the classification eg the formations 'CG' (which covers calcicolous grasslands), 'M' (mires) and 'H' (heaths) are described in separate sections. An attempt is made below to draw the broad floristic distinctions between these formations and the formation 'U' which includes dry acid grasslands.

U - incorporates dry acid grassland

The Handbook for Phase 1 Habitat Survey (NCC, 1990) lists *Deschampsia flexuosa* , *Nardus stricta* , *Juncus squarrosus* , *Galium saxatile* and *Rumex acetosella* as species characteristic of acid grassland when frequent or abundant. Although *Juncus squarrosus* is much more characteristic of wet heath in the lowlands and *Nardus* can be prominent in *Junco-Molinion* communities, the list is generally useful.

In addition to these, there are other widespread indicative species such as the vascular plants *Aira praecox, Ornithopus perpusillus, Filago minima* and *Agrostis curtisii,* and the mosses *Polytrichum juniperinum, Polytrichum pilulifera* and *Pleurzium schreberi.* Many local species are also distinctive, especially within the more xeric types of U1 (Festuca ovina-Agrostis capillaris-Rumex acetosella) grassland.

M - incorporates wet acid grassland

Wet acid grasslands can be separated by the abundance of species such as *Molinia caerulea, Agrostis canina* and *Juncus acutiflorus* as well as the presence of species such as *Pedicularis sylvatica, Lotus pedunculatus, Carex panicea, Carex viridula oedocarpa, Carex nigra* and *Carex echinata.* Many of these species also occur in base rich fen meadow but are absent from dry acid grasslands.

H - Heaths

Heaths can be separated from acid grasslands by the presence of dwarf shrubs. However, the distinction can be very difficult, some herb-rich heath communities are essentially acid or even calcicolous grassland with a high cover of *Calluna vulgaris.* (For the purposes of this report, the term heath is used to indicate communities dominated by ericaceous species, and heathland is used to describe areas of rough grazing in which some heath is present).

CG - Calcicolous Grasslands

Acid and calcicolous grassland are separated geographically in many areas, but very gradual gradations occur in areas such as Breckland. Here the most practical definition appears to be the absence of calcifuges (lime-haters), eg *Rumex acetosella,* and the abundance of species traditionally regarded as calcicoles (lime-lovers) in calcicolous grasslands, eg *Helianthemum nummularium, Hippocrepis comosa* and *Scabiosa columbaria.* Supposed calcicoles such as *Thymus polytrichus, Cirsium acaule* and *Linum catharticum* can sometimes occur in acid grassland at low frequencies.

MG - Neutral (mesotrophic) Grasslands

The problem of separation of 'neutral' grassland from acid grasslands is rather similar to that of the separation of acid and calcicolous grasslands, in that species generally characteristic of communities such as MG5 or MG6, eg *Festuca rubra* and *Cynosurus cristatus* can also occur at lower levels within several acid grassland communities. Here the positive occurrence of acid grassland species appears to be the most practical method of separating the two types of grasslands.

2.2 Altitude and the definition of lowland acid grassland

The lower limit of lowland acid grassland is defined according to the transition to maritime grasslands on the coast. This limit is relatively easy to define and is usually considered as the switch from acid grasslands such as NVC community Festuca-Agrostis-Rumex grassland (U1), to maritime grasslands such as the Armeria maritima - Cerastium diffusum maritime therophyte community (MC5) and the Festuca rubra-Armeria maritima maritime community (MC8) (Rodwell in prep.).

The upper altitudinal limit of lowland grassland is much more difficult to define. The working definition at the start of the review was:

"Lowland acid grassland is generally found below 350 metres and does not include unenclosed rough grazing land above the moor wall."

From the consultations with Local Team staff it became clear that the definition of lowland acid grassland varies across the country. Many of those consulted found the 350m limit rather high. Land use definitions were found useful in some areas, especially the south-west. Here the boundaries of Less Favoured Areas are taken to mark the divide between lowland and upland, but it was commented that in this region at least, there was little ecological difference between the acid grasslands of the uplands and the lowlands. A common response, however, was that there was a greater difference between the acid grasslands of the enclosed upland fringes below 250 or 350m and those of truly lowland conditions beyond the hills, compared with upland fringe acid grassland the truly upland grasslands above the moor wall.

A common theme was that where acid grassland of interest occurred in the upland fringes, it tended to be parched acid grassland, Festuca-Agrostis-Rumex grassland (U1), with a strong lowland character, for example on south facing slopes of igneous rocks in Shropshire and Northumberland. The Welsh Phase 2 surveys of acid grassland experienced the same problem of defining lowland grassland. Often little land lay below 200m but 'lowland' plant communities such as MG5 could be found at altitudes of over 350m. Generally, upland fringe or fridd areas (often in the form of defunct enclosures immediately below the unenclosed upland grazings) were not included in assessments of lowland acid grassland (Dr Carrie Rimes, Countryside Council for Wales, pers. comm.). In the few instances where specific interest was attributed in England to more typical moist acid grasslands of the upland fringe, including Festuca-Agrostis-Galium grassland (U4), the interest tended to relate to the adjacent uplands, eg in West Yorkshire, the enclosed grasslands, including acid grasslands, are important feeding grounds for internationally important populations of waders breeding on the moors above. (Colin Newlands, English Nature, pers. comm.)

Upland fringe acid grassland can be extensive, eg in Cumbria, where it is considered that there is between 30,000-50,000ha of acid grassland below 300m but only between 500-1,000ha is found beyond the upland fringe (Ian Slater, English Nature, pers. comm).

The variability in altitudinal definition of lowland grassland and consequent variation in amounts of upland fringe grassland that could be included led to the following definitions being used in this review:

- **Upland acid grassland**

  Acid grasslands within extensive moorland grazings. Very rarely, distinctively lowland type acid grasslands may occur in favourable locations at lower altitudes.

- **Upland fringe grasslands**

  Acid grasslands within enclosed landscapes in the hills. These grasslands are often part of the same pastoral system as the nearby moors and generally have a closer ecological and land use relationship to the uplands than the lowlands. Very rarely, distinctively lowland-type acid grasslands may occur in favourable locations.

- **Lowland acid grasslands**

  Acid grassland beyond the hills.

  This report deals mainly with the last category, but grasslands of a distinctively lowland character which occur in the upland fringe or the uplands are also considered.

2.3 Description of core and associated lowland acid grassland NVC communities

2.3.1 Introduction

When considering the NVC, or any other vegetation classification, it is important to remember that such classifications are an abstraction of reality. Vegetation communities have no real existence and are simply convenient divisions of a continuum. An important function of a vegetation classification scheme is to provide an objective framework to allow meaningful comparisons to be made between different areas and sites. Given this, it should be remembered that transitions and odd stands are to be expected and the fact that a vegetation stand does not easily 'fit' into a classification does not necessary imply any lack of nature conservation interest.

The core and associated NVC communities which make up lowland acid grasslands are listed and briefly described below from Rodwell (1992) and Rodwell (in prep.), although some more recent experience is also incorporated. The NVC communities that are closely associated with acid grasslands in the lowlands are usually very localised in contrast to the core communities. As well as fragments of acid grasslands more typical of the uplands, these associated types include inland sand dune communities and species-rich Bracken stands.

2.3.2 Summary list of core and associated acid grassland NVC communities

Core NVC acid grassland communities and sub-communities	
U1	*Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland U1a: Cornicularia aculeata-Cladonia arbuscula sub-community U1b: Typical sub-community U1c: Erodium cicutarium-Teesdalia nudicaulis sub-community U1d: Anthoxanthum odoratum-Lotus corniculatus sub-community U1e: Galium saxatile-Potentilla erecta sub-community U1f: Hypochaeris radicata sub-community
U2	*Deschampsia flexuosa* grassland U2a: Festuca ovina-Agrostis capillaris sub-community
U3	*Agrostis curtisii* grassland Undescribed lowland sub-communities
U4	*Festuca ovina-Agrostis capillaris-Galium saxatile* grassland U4a: Typical sub-community U4b: *Holcus lanatus-Trifolium repens* sub community U4c: *Lathyrus montanus-Stachys betonica* sub-community
Associated NVC acid grassland communities and sub-communities	
SD10	*Carex arenaria* community SD10b: *Festuca ovina* sub-community
SD11	*Carex arenaria-Cornicularia aculeata* community SD11b: Festuca ovina sub-community
U20	*Pteridium aquilinum-Galium saxatile* community U20a: *Anthoxanthum odoratum* sub-community, specifically species-rich variants
U2	*Deschampsia flexuosa* grassland U2b: *Vaccinium myrtillus* sub-community
U3	*Agrostis curtisii* grassland Undescribed upland sub-community
U4	*Festuca ovina-Agrostis capillaris-Galium saxatile* grassland U4d: *Luzula multiflora-Rhytidiadelphus loreus* sub-community U4e: *Vaccinium myrtillus-Deschampsia flexuosa* sub-community
U5	*Nardus stricta-Galium saxatile* grassland
U6	*Juncus squarrosus-Festuca ovina* grassland

2.3.3 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland (U1)

Introduction

This is the main acid grassland type of the south and east of England and is almost entirely lowland in its distribution. It is sometimes referred to as lichen heath or grass heath and occasionally is called 'breckland grassland' (eg Rose, 1995) but this is an unsatisfactory name for general use as the community occurs widely beyond Breckland. The name 'parched acid grassland' is here proposed as a more comprehensive term and is used to denote U1 in this review.

The community (U1)

There are only three community constants listed by the NVC: *Festuca ovina* agg., *Agrostis capillaris* and *Rumex acetosella*. Of these only *Rumex acetosella* is largely confined to Festuca-Agrostis-Rumex grassland (U1). The preferential species vary with the sub-communities and are discussed below.

The distinction between Festuca-Agrostis-Rumex Grassland (U1) as a whole and the Festuca-Agrostis-Galium Grassland (U4) can be difficult to make. The NVC does not record any *Rumex acetosella* in 342 samples of U4 so the presence of this species alone is fairly diagnostic of U1, as delineated by the NVC. Associated species which are recorded reasonably frequently in U1, and which, like *Rumex acetosella*, were not recorded by the NVC from U4, include *Aira praecox*, *Erodium cicutarium*, *Aphanes* sp, *Teesdalia nudicaulis*, *Ornithopus perpusillus*, *Filago minima*, *Leontodon saxatilis*, *Pilosella officinarum*, *Plantago coronopus*, *Carex arenaria*, *Brachythecium albicans*, *Polytrichum juniperinum*, *Polytrichum piliferum*, *Cladonia arbuscula*, *Cladonia furcata*, *Cladonia portentosa* and *Coelocaulon aculeatum*.

At the extremes, U1 and U4 are very different communities, although the boundary is very diffuse. The Galium saxatile-Potentilla erecta sub-community (U1e) of parched acid grassland comes closest to U4 and separation can be difficult (Woods 1993). In Radnorshire, Woods (1993) describes U1c as having at least a few annual species such as *Aira praecox*, which are absent from U4.

The differentiation of U1 and U4 is therefore achieved marked by the absence of all of the above species from U4. If this reasoning is followed, then it is possible that the U4 community has been over-recorded in the south and east by past surveys. This is exemplified on the Humberside Coversand survey where most quadrats recorded as U4 contain *Rumex acetosella* (Wigginton 1990) and could be described as being closer to U1 than U4. A further problem is presented by rank, ungrazed, acid grasslands since much of the character of the two communities is lost in anonymous stands dominated by *Festuca ovina* and *Agrostis capillaris*.

Cornicularia aculeata (*Coelocaulon aculeatum*)-*Cladonia arbuscula* sub-community (U1a)

This is a distinctive sub-community when well developed, with a high cover of lichens and mosses characteristic of very nutrient-poor soils, for instance the *Cladina* section of the lichen genus *Cladonia*, including *Cladonia arbuscula*, *Cladonia ciliata tenuis*, *Cladonia portentosa* and *Cladonia uncialis*, and the mosses *Dicranum scoparium* and *Polytrichum piliferum*.

The least indicative lichens are *Coelocaulon aculeatum* and *Cladonia furcata* which occur widely in other sub-communities. Some lichen determinations may be somewhat suspect in the NVC and perhaps should not be relied on too heavily (Dr. F. Rose, pers. comm. 1996). The cup *Cladonia* species are especially prone to mis-identification but the split between *Cladonia portentosa* and *Cladonia arbuscula* is also difficult and should always be confirmed by chemical spot tests.

Typical sub-community (U1b)

This sub-community is marked by the absence or limited development of the species assemblages characteristic of the other sub-communities, and therefore can include very impoverished swards. More usual however, is the presence of species typical of U1a and U1c but at lower densities than characterize U1a and U1c. The partition of stands between these sub-communities can thus present problems.

Erodium cicutarium-Teesdalia nudicaulis sub-community (U1c)

This is the most species rich sub-community, with spring ephemeral annuals especially prominent. As well as the vegetation sampled by the NVC in Breckland, stands have been noted in the eastern Weald which closely match the described NVC community (Sanderson & Stanbury 1996).

Related stands have been recorded on shallow parched soils over basalitic rocks (Dalby 1991 and Woods 1993) or on mine waste (Regini 1994) in the north and west. Several surveys late in the season found problems in detecting this sub-community (Wigginton 1990, Smith & James 1995 & Smith 1996) but the abundance of the perennial *Erodium cicutarium* on very bare ground should at least indicate its likely presence in late summer.

Anthoxanthum odoratum-Lotus corniculatus sub-community (U1d)

This sub-community is marked by the appearance of somewhat more base demanding species such as *Galium verum* and *Lotus corniculatus* and grades into Festuca ovina-Hieracium pilosella (Pilosella officinarum)-Thymus praecox (polytrichus) grassland (CG7) in Breckland. In the New Forest this assemblage of species in U1d is usually mixed with those of U1f, often with a scatter of calcicoles not recorded by the NVC.

Galium saxatile-Potentilla erecta sub-community (U1e)

Close to both Festuca-Agrostis-Galium grassland (U4) and Deschampsia flexuosa grassland (U2), this sub-community is separated from the former by the presence of annuals and the latter by the low cover of *Deschampsia flexuosa* (less than 10%).

Hypochaeris radicata sub-community (U1f)

This sub-community is represented by only fifteen samples in the NVC, and several authors, whilst recognising that it covers a distinctive type of south-western grassland, have found that the NVC fails to fully describe the range of vegetation which could be attributed to it (Leach *et al* 1994; Porley 1992 & 1993; and Woods 1993).

General characteristics of the sub-community include the prominence of rosette herbs including *Hypochaeris radicata*, *Leontodon saxatilis* and *Plantago coronopus* and a tendency for *Festuca rubra* to replace *F. ovina* agg. In Dorset and the New Forest, odd features occur in stands occurring on heavily grazed commons, and include the local abundance of *Danthonia decumbens* and *Nardus stricta* in communities which are firmly within the continental *Thero-Airion* phytosociological alliance and are closest to the U1f. Annual *Trifolium* and *Lotus* species and *Vulpia bromoides* are also characteristic of some stands but are not represented in the NVC samples.

2.3.4 *Deschampsia flexuosa* grassland (U2)

Introduction

This is a widespread community of acid soils in heathland and moorland areas, both in the uplands and lowlands. It occurs mainly as a component of extensive rough grazings or in relics of such systems. It often appears to replace heath where habitat degradation has occurred. This grassland community is rarer in the south-west where it is partly replaced by *Agrostis curtisii*-dominated grasslands. The 'common' name for this community is 'grass heath'.

The community (U2)

The community contains two constants; *Deschampsia flexuosa* at Domin cover abundance value of 4 (4-10%) or more, and *Calluna vulgaris* at Domin cover abundance value of 5 (10-25%) or less. The dominance of *Deschampsia flexuosa* is distinctive but this species is a natural component of several types of heath, especially Calluna vulgaris-Ulex minor heath (H2) and Calluna vulgaris Deschampsia flexuosa heath (H9). The partition of heath and grass heath is, of necessity, somewhat arbitrary.

Festuca ovina-Agrostis capillaris **sub-community (U2a)**

This sub-community is marked by the presence of a number of typical acid grassland species such as *Galium saxatile*, *Potentilla erecta*, *Festuca ovina*, *Agrostis capillaris*, *Polytrichum piliferum* and *Rumex acetosella*. The distinction from related heath concerns low *Calluna* cover and the presence of a greater number of acid grassland species.

U2a is the main sub-community of U2 in the lowlands, where in many cases, it may be a recent artefact of lack of grazing. *Deschampsia flexuosa* is very sensitive to cattle, pony and rabbit grazing, although is less affected by sheep grazing. Grazing is likely to convert U2a to U1e or U4. Indeterminate stands are therefore to be expected and fairly rapid switches between the communities may be produced by changes in the grazing pressure.

Vaccinium myrtillus **sub-community (U2b)**

This is an essentially upland sub-community characterised by the constants *Vaccinium myrtillus* and the moss *Pleurozium schreberi*, along with species such as *Empetrum nigrum* and *Eriophorum vaginatum*. This sub-community is unlikely to be encountered in much of the lowlands.

2.3.5 *Agrostis curtisii* grassland (U3)

Introduction

This is a localised community of acid soils in lowland heathland and upland moorland areas, confined to the south-west of the country. It is mainly a component of extensive rough grazings or relics of such systems. This community has attracted little previous attention and the NVC account is rather provisional. The most appropriate 'common' name is again 'grass heath'.

The community (U3)

The community is characterised by the dominance of *Agrostis curtisii*. The NVC table is drawn from only 18 samples. *Agrostis curtisii*, *Potentilla erecta*, *Calluna vulgaris*, *Festuca ovina*, *Galium saxatile* and *Danthonia decumbens* are constants. The range of variation covered by this community is probably at least as large as that for U2, but the NVC sampling was too limited to divide the community into sub-communities. Further sampling would probably reveal an upland *Vaccinium myrtillus* sub-community, a fairly diverse, grazed, lowland sub-community lacking *Vaccinium myrtillus*, and an impoverished, ungrazed, *Agrostis-curtisii* dominated sub-community.

In the lowlands there is a gradation from dry stands with *Aira praecox* to damper stands with *Molinia caerulea*. Occasional species such as *Stachys officinalis*, *Succisa pratensis*, *Carex montana* and *Serratula tinctoria* occur in flushed stands in the New Forest. *Agrostis curtisii* also occurs in several types of heath (Ulex minor-Agrostis curtisii heath (H3) and Ulex gallii-Agrostis curtisii heath (H4)) and a gradual merging between these heath types and U3 grass heath is likely to be frequently encountered.

2.3.6 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland (U4)

Introduction

This community replaces the Festuca-Agrostis-Rumex grassland (U1) in the uplands and in the lowlands in the north and west, where rainfall is higher and evaporation is lower. It can cover large areas within extensive rough grazings and can replace heath communities under high levels of sheep grazing. To many conservationists it is synonymous with acid grassland, but a more accurate 'common name' would perhaps be 'moist acid grassland' to distinguish it from the Festuca-Agrostis-Rumex grassland (U1). This common name is used for U4 in the review.

The community (U4)

The distinction of this community from the Festuca-Agrostis-Rumex grassland (U1) is dealt with above. The NVC gives five community constants; *Agrostis capillaris*, *Anthoxanthum odoratum*, *Potentilla erecta*, *Festuca ovina* and *Galium saxatile*.

Typical sub-community (U4a)

This community is characterised by the sparse occurrence of species particular to other sub-communities.

Holcus lanatus-Trifolium repens sub-community (U4b)

This sub-community is distinguished by the frequency of species typical of more nutrient-rich conditions such as *Holcus lanatus*, *Achillea millefolium*, *Trifolium repens* and *Cerastium fontanum*. It is essentially a transition between U4 and swards such as Lolium-Cynosurus grassland, Anthoxanthum sub-community (MG6b).

Lathyrus montanus (linifolius)-Stachys betonica (officinalis) sub-community (U4c)

This sub-community has been defined by eighteen samples from the Derbyshire Dales, typically from areas of drift over limestone. It is defined as U4 grassland with species typical of calcicolous grasslands such as *Helictotrichon pratensis*, *Koeleria macrantha* and *Briza media*, and also species of more acid soils such as *Lathyrus linifolius*, *Stachys officinalis* and *Succisa pratensis*. *Viola lutea* is strongly characteristic of the sub-community.

The extent to which the sub-community occurs beyond the Derbyshire Dales is not clear. The *Stachys officinalis/Succisa pratensis* assemblage occurs widely in many communities including Cynosurus-Centaurea grassland Danthonia sub-community (MG5c), Agrostis curtisii grassland (U3) and Pteridium-Galium community (U20) and the occurrence of this assemblage in an acid grassland does not automatically imply it is synonymous with U4c.

Other sub-communities (U4d and U4e)

Two further sub-communities of U4 are described in the NVC (Luzula multiflora-Rhytidiadelphus loreus sub-community (U4d) and Vaccinium myrtillus-Deschampsia flexuosa sub-community (U4e)). Both of these are predominantly upland sub-communities.

2.3.7 *Nardus stricta-Galium saxatile* grassland (U5)

The NVC did not sample any vegetation dominated by *Nardus* in the lowlands. *Nardus* is in fact quite widespread in lowland acid soil areas but it mostly occurs as an associated species in unrelated wet acid grassland (*Molina* and *Juncus* types), wet heath and mire. In the New Forest it can even be locally abundant in U1f vegetation. Vegetation dominated by *Nardus* (ie Nardus-Galium grassland (U5)) does occur in the lowlands but reported stands are small and appear intermediate with other acid grasslands (Wigginton, 1990).

2.3.8 *Juncus squarrosus-Festuca ovina* grassland (U6)

The NVC did not sample any *Juncus squarrosus*-dominated vegetation in the lowlands. It has been recorded (Wigginton, 1990) but most lowland *Juncus squarrosus* occurs in wet heath, where patches that are dominated by it bear little resemblance to U6.

2.3.9 *Carex arenaria* in inland lowland acid grasslands

Introduction

Carex arenaria occurs in sandy acid grasslands in Breckland, on Lincolnshire Coversand heaths, the west Wealden heaths and the sand terraces of the Hampshire Avon. The NVC recorded *Carex arenaria* in several sub-communities of Festuca-Agrostis-Rumex grassland (U1) with the highest cover found in the Anthoxanthum-Lotus sub-community (U1d) at Domin cover value 7 (34-50%). One survey of the Suffolk Breckland (Smith 1996) identified Carex arenaria-Festuca ovina-Agrostis capillaris grassland (SD12) from Cavenham and Icklingham Heaths. The constancy table produced, however, shows a vegetation indistinguishable from U1d in which the NVC allows a high cover of *Carex arenaria*. Carex-Festuca-Agrostis Grassland (SD12) is basically a northern grassland and it is unlikely that it occurs in inland southern sites. Two *Carex arenaria* communities have, however, been recorded from the lowlands and are described below.

Carex arenaria community, *Festuca ovina* sub-community (SD10b)

This sub-community of the *Carex arenaria* community includes stands dominated by tall, rank, *Carex arenaria*. For the most part it appears to be a result of lack of grazing, deriving from U1 or the Carex-Cornicularia Community (SD11). It has been recorded from the Weald by EPR in 1996, as well as from the east of England by other surveyors (Wigginton 1990 and Smith 1996).

Carex arenaria-Cornicularia aculeata (Coelocaulon aculeatum) community, *Festuca ovina* sub-community (SD11b)

This is distinguished from U1 sub-communities with *Carex arenaria* (U1b, U1c, U1d) by the high cover of the lichens *Coelocaulon aculeatum* and *Cladonia* species. It has been recorded from the Weald (Sanderson and Stanbury 1996) as well as the east of England (Wigginton 1990 and Smith 1996).

2.3.10 *Pteridium aquilinium* in lowland acid grasslands

Two Bracken dominated NVC communities are present in lowland acid grasslands: Pteridium aquilinum-Galium saxatile community (U20) in very acidic situations, and Pteridium aquilinum-Rubus fruticosus underscrub (W25) on less extreme soils and sometimes in ungrazed situations. Some stands of both communities can be quite herb-rich and can support a varied flora including grassland and woodland species, eg *Anemone nemorosa, Stachys officinalis, Succisa pratensis, Serratula tinctoria, Carex montana* and *Botrychium lunaria*.

3. Methods used to assess the extent of the resource

3.1 Introduction

Comprehensive information on the extent and types of lowland dry acid grasslands is lacking for England. To provide a provisional estimate of the extent of the resource, a range of methods were used, are are described in the following section.

3.2 Geology and soil

3.2.1 Geology

The Geological Survey's solid geology maps show the general distribution of rock types likely to have acid soils. However, some acidic soils have developed from material overlying more base-rich rock. General reference was made to the geology of each county and Natural Area (see Volume II) but soil information was found to be more useful for defining the likely extent of the acid grassland resource.

3.2.2 Soils

Soil maps not only reflect the influence of geology but also other factors such as topography and climate. As such they provide a much more sensitive way of assessing likely extent of ground conditions that would potentially support acid grassland. An important reference is the soil association map of England and Wales at 1: 250 000 scale (Soil Survey of England and Wales 1983). A generalized picture of the extent of acid soils in England was adapted from the soil association map (**Map 1a-1f**).

The broad groups shown on **Map 1**, and described below, incorporate soil associations where the predominant soil type is acidic in character, although other soil types will also occur in these areas.

- **Brown sands**: all soil associations where non-calcareous, sandy, soils, ie calcium carbonate content of less than 1% (Brown Sands) are dominant are shown, except for periodically waterlogged sands with clay-enriched layers (Gleyic Argillic Brown Sands). Only the Downham Association is dominated by the latter type of soil and is largely confined to the eastern margins of the Fens where sandy soils are affected by high groundwater. It does not appear to support any acid grassland. Brown sands tend to be heavily cultivated but where semi-natural vegetation occurs, acid grassland can often dominate over heath.

- **Lowland podzolic soils**: podzolic soils usually result from soil formation in acid conditions and often have an acid organic layer at the surface when the soil has not been disturbed by cultivation. The lowland group comprises well-drained Podzols and periodically waterlogged Gley Podzols. Semi-natural vegetation on these soils will usually be dominated by heath rather than acid grassland.

- **Brown podzolic soils**: these lack the bleached layer seen in other podzols and are termed Typical Brown Podzolic Soils. They are essentially upland and western soils and typically span the transition between upland and lowland conditions.

- **Upland acid soils**: this group includes truly upland soils, including mixtures of shallow soils over rock (Humic Rankers), podzols and gley soils with peaty or humus-rich topsoils (Humic Brown Podzolic soils, Stagnopodzols, Stagnohumic Gley Soils) and raw peat soils. The group is included to indicate the extent of purely upland conditions.

3.3 Distribution of characteristic plant species

Lowland acid grasslands harbour many distinctive species that tend to be confined or nearly confined to this habitat type. Plant distribution maps were therefore identified as a source of information that could be used to indicate areas where acid grassland may still survive in the lowlands. First, lists of characteristic plant species of lowland acid grassland and associated habitats were generated using the following sources:

- Identification floras (Streeter 1983 and Stace 1991)
- Local floras (Dony 1976, Lousley 1976, Trist 1979, Hall 1980, Ivimey-Cook 1984, Sinker *et al* 1985, Woods 1993, Rose 1995a and Brewis *et al*, 1996)
- Species accounts in:
  - ☐ Scarce plants in Britain (Stewart *et al* 1994)
  - ☐ The Atlas of the British Flora (Perring & Walters 1976)
  - ☐ The National Vegetation Classification (Rodwell 1992)
  - ☐ Grassland survey reports (Wigginton 1990, Dalby 1991, Sanderson 1994a, Smith & James 1995, Smith 1996, Sanderson & Stanbury 1996 and Byfield & Pearman, 1996).

Four groups of species were developed, and for three of these groups 'coincidence maps' of records on a 10 kilometre square basis were produced by the Biological Records Centre, Monkswood. The maps show the distribution of these groups of species and also the number of species belonging to the group in each 10km square. In addition three maps of individual species were produced to help define potential acid grassland areas. The groups and species were:

Species generally faithful to lowland acid grassland

This group consists almost entirely of species associated with parched acid grassland (Festuca-Agrostis-Rumex grassland U1) and to a much lesser extent, Bristle Bent grass heath (Agrostis curtisii grassland U3). The species are listed in **Table 1** and the list was used to produce **Map 2** which shows records from all dates. To get a more up-to-date picture, records from post-1970 were examined. However, eight species had not been recently updated by the BRC and thus the post-1970 map was somewhat misleading. To overcome this problem **Maps 3-4** were produced using only the 25 species that had been up-dated. **Map 3** shows all records and **Map 4** only post-1970 records of the up-dated species.

Species of ephemeral ponds

Species found in the mud of ephemeral ponds within acid grasslands form a distinctive group (**Table 3**). These species were used to produce **Maps 5-7**. Three maps were produced, showing pre-1970, post-1970 and all records.

Species of disturbed acid sandy soils

These species are sometimes associated with acid grassland, but are usually absent from the main grassland sward (**Table 4**). They are more often found in ungrazed situations such as low intensity arable land and waysides in acid grassland landscapes. This list of species was used to produced **Maps 8-10**. Three maps were produced showing pre-1970, post-1970 and all records.

Single species distributions

The species chosen were:

- ☐ *Carex arenaria*: a species confined to very sandy soils at its inland locations (**Map 11**). It is a key component of SD10 and 11 (sand-dune) communities and also occurs in U1 grassland.
- ☐ *Agrostis curtisii*: the dominant species of Agrostis curtisii grassland (U3) (**Map 12**).
- ☐ *Viola lutea*: an upland species which is fairly faithful to Festuca-Agrostis-Galium grassland (U4) grassland (**Map 13**). It indicates the areas with acid grassland of more upland character.

Species locally characteristic of acid grasslands

These species are also found in other habitats and therefore are not of value in mapping the national distribution of this habitat type (**Table 2**). However, they are listed in the report because when they are combined with the faithful species they provide a basis for an 'indicator species list' to measure the floristic quality of lowland acid grasslands (see Chapter 5).

3.4 County by county review of site-based information

3.4.1 Survey and Inventory information

Over the last two decades, English Nature has carried out a considerable number of Phase 2 grassland surveys using the NVC as a basis for vegetation mapping. However, there have been only a few specific acid grassland surveys. Summary reports from these surveys were examined.

As well as these few surveys, there have been other more general habitat surveys that have been carried out by NGOs, most especially the Wildlife Trusts, and Local Authorities to both the Phase 1 and Phase 2 level. English Nature has produced an inventory of lowland unimproved grasslands surveyed between 1980 and 1996 for each county (County Grassland Inventories). The Inventories are a collation of Phase 2 survey results and other accessible data. The Inventories show where unimproved grassland and its broad type has been recorded but do not specify the NVC community types. Instead they act as an index for more detailed site information (Jefferson *et al* 1997). Each County Inventory was inspected together with other sources, principally County Heathland Inventories and Biological Survey of Common Land reports. The Heathland Inventories show lowland sites which have heath vegetation (English Nature and Royal Society for the Protection of Birds 1994-1996).

3.4.2 Personal communication

The survey and Inventory information is very mixed in its level of coverage of acid grassland. Given this range in information, it was clearly important to establish personal contact with people with local knowledge in an attempt to fill in gaps in the existing data. This was done by contacting English Nature Local Team staff and in some cases other local conservationists. The people consulted are listed in **Appendix 3, Volume II**. Information was requested in a standardised way by using a questionnaire (see **Appendix 4, Volume II)**

In addition to the questions listed in **Appendix 4, Volume II**, Teams with upland areas in their remit were asked their opinion as to the separation between upland and lowland acid grassland (see Chapter 2).

3.5 Geographical framework: counties and Natural Areas

There were two possible national frameworks for presentation of the information collected by the above methods. Either counties or English Nature's Natural Areas could have been used. Counties had the advantage of being the form in which most of the existing data has been collected and presented, including the County Grassland and Heathland Inventories. In contrast, Natural Areas were a new concept and little existing data had been organised according to their boundaries. Ideally, the use of Natural Areas would be preferred for the description of natural resources, in that they represent areas with more coherent ecological meaning than do counties.

However, the fact that the existing data on both species and sites has been collected in the form of counties has meant that the review had to be organised by county. Wherever possible, reference is made to Natural Areas within counties. One problem was that the draft Natural Areas map originally used in the contract (**Map 14**) was significantly altered in the final version (**Map 15**). The information has been updated so that it relates to the new Natural Areas, except for **Map 1**, which shows soil types.

For each county the acid grassland resource is described according to a series of physical, geographical and historical headings. A summary review of the existing information available for acid grassland communities and flora that occur in the county is given and the results of consultations with local conservation officers also presented. Comments on management condition and nature conservation interest of acid grassland are also summarized. This county information is bound separately in **Volume II**.

For each county the data abstracted from survey reports were entered into a spread sheet. Estimates of the total area of the overall lowland acid grassland present were made for each county, together with estimates for each NVC community and sub-community where possible. The resulting tables are given for each county in **Volume II**, and are summarized for the whole of England in **Table 5**, **Volume I**.

4. Extent of lowland acid grassland and component NVC communities in England

4.1 Introduction

The information on the extent and distribution of acid grassland derived from the various lines of enquiry described in Chapter 3 is summarized below. More detailed information on a county basis is given in **Volume II**. As well as estimates for the extent of acid grassland in different parts of England, the typical locations of acid grassland in the landscape of the lowlands is described in the following chapter. Actual examples are given in **Appendix 1**. The estimates of extent of acid grassland in each county were made by using area classes. These area classes have been converted into overall low, medium and high estimates for different types of grassland as follows:

			Estimates (ha)		
Area class	**Range (ha)**	**No. of counties**	**Low**	**Medium**	**High**
A	1-50	j	10 X j	25 X j	50 X j
B	50-100	k	50 X k	75 X k	100 X k
C	100-500	l	100 X l	250 X l	500 X l
D	500-1000	m	500 X m	750 X m	1000 X m
E	1000-5000	n	1000 X n	1500 X n	2000 X n

The upper, lower and mid-points of area classes are used for all except class E. Here local estimates were usually qualified as being 'near 1000' so it was felt that using figures lower than 2500 and 5000 for the mid and upper limits of the class would provide a more realistic estimate. The county by county estimates are summarized in **Table 5**. Very rough estimates for sub-communities are also made in **Table 5**.

4.2 Total area of lowland acid grassland

		Estimates (ha)		
Area class	**No. counties**	**Low**	**Medium**	**High**
A	11	110	275	550
B	6	300	450	600
C	14	1400	3500	7000
D	8	4000	6000	9000
E	3	3000	4500	6000
Totals	**42**	**8810**	**14725**	**22150**

The estimates range between 9,000 to 22,000ha, with the true total more likely to be between 15,000 and 22,000ha. This matches well with the previous estimates made by Jefferson & Robertson (1996) of between 10,000 to 20,000ha for the total area of lowland acid grassland in England.

The geographical distribution of estimates for the total area of acid grassland by county is shown on **Map 16**. Hampshire, Suffolk and Norfolk are the only counties where more than 1,000ha of acid grassland has been recorded, with between 500-1,000ha estimated for Cumbria, Dorset, Greater London, Hereford and Worcester, Kent, Somerset, Surrey and Sussex (East and West). Between 100-500ha were estimated from Berkshire, Cornwall, Devon, Essex, Gloucestershire, Hertfordshire, Humberside, Isle of Wight, Leicestershire, Lincolnshire, North East England, Nottinghamshire, Shropshire and Staffordshire. Other counties were estimated as having less than 100ha of lowland acid grassland.

The consultation exercise suggested that significant areas of upland fringe acid grassland occurred in the following areas: Cheshire, Cornwall, Cumbria, Derbyshire, Devon, Greater Manchester, Hereford and Worcester, Lancashire, North East England, North Yorkshire, Shropshire, Staffordshire, Somerset and West Yorkshire.

4.3 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland (U1)

4.3.1 Community estimates

The area estimates and distribution pattern for parched acid grassland (U1) by county are given in **Table 5** and **Map 17**. Overall estimates are:

		Estimates (ha)		
Area class	**No. counties**	**Low**	**Medium**	**High**
A	18	180	450	900
B	7	350	525	700
C	8	800	2000	4000
D	3	1500	2250	3000
E	2	2000	3000	4000
Totals	**38**	**4830**	**8225**	**12600**

The estimates range between 5,000-12,500ha, with the true total more likely to be between 8,000-12,500ha. Hampshire and Norfolk are the only counties where more than 1,000ha of parched acid grassland has been recorded.

The coincidence maps of characteristic lowland acid grassland plant species (**Maps 2-4**) reflect, to a large extent, the distribution of U1. **Map 2** shows all records from all dates and thus indicates the probable maximum distribution of the community. This extends beyond the samples of U1 in the published NVC. In fact, U1 has now been recognised in these unsampled areas, eg in Scotland (Cooper and Mackintosh 1996). **Maps 3** and **4** indicate that there has been a great loss of habitat area and quality in recent years.

Soils

There is a strong association between the distribution of parched acid grassland species and U1 and the occurrence of soil associations dominated by brown sands or lowland podzolic soils over most of lowland England (**Map 1**). To the north, towards the borders of Wales and in the south-west, the strength of this association is much reduced. The county consultations indicate that in the first two areas, parched acid grassland floras are associated with small areas of shallow, rocky, soils (rankers) over hard igneous rocks, while in the south west they are best developed in cliff top grassland, also on rankers.

Some stands of U1 have replaced heath on sites where podzols have been disturbed. This disturbance is often recent but can include situations where ancient disturbance has occurred, eg by wind blown erosion as in Breckland, or by constant low level disturbance near settlements, as in the New Forest.

Climate

Map 2 shows that the diversity of parched acid grassland species per 10 km square declines to the north and west of England and higher diversity areas become increasingly coastal in distribution. Comparison of **Map 2** with a measure of soil moisture deficit (Bendelow and Hartnup 1980) indicates a striking correlation. The measure of moisture deficit is calculated by subtracting potential transpiration from actual rainfall on a monthly basis, and summing the monthly deficits to find the maximum potential deficit for the year. The averae of these maxima for a period of years is then calculated (Bendelow and Hartrup 1980). Areas with rich parched acid grassland floras are largely restricted to parks of England with a deficit of greater than 100mm (**Map 18**).

The equivalent map for Scotland (Birse & Dry, 1970) shows areas supporting diverse lowland acid grassland concentrated in areas with a potential moisture deficit of greater than 75mm (**Map 18**). The measure used by Birse and Dry for Scotland is slightly different, though correlated to, the measure used by Bendelow and Hartrup (1980). Potential moisture deficit is calculated by subtracting potential transpiration from rainfall data for the six summer months only (Birse and Dry 1970, Green 1964).

Rich areas such as Breckland and the New Forest both have similar deficits of just under 180mm. Although Breckland is drier than the New Forest, the latter is warmer, hence the two areas have similar moisture deficits. The floristically rich Shropshire Hills are notable as the only upland area with a deficit of more than 100mm. Dartmoor and parts of the south west, and the small area in the Eden Valley north of Penrith in Cumbria are the only places where concentrations of acid grassland species occur in England where the moisture deficit is lower than 100mm.

Landscape

The majority of significant stands of parched acid grassland are either within extensive heathland landscapes or are the relics of the enclosure of such extensive pastoral systems (eg New Forest examples, Humberside Coversands, **Appendix 1**). The enclosure relics include mown areas of golf courses and military air fields. In heathlands, the acid grasslands are often associated with areas of former (usually 20th century) disturbance or cultivation (eg New Forest examples, **Appendix 1**).

Other landscape types from which parched grasslands have been recorded include:

- Parklands on acidic soils, with some significant sites, especially in Kent, Sussex and London (eg Hatch Park SSSI, **Appendix 1**).
- Areas of sandy alluvium in the raised parts of flood plains or on terrace edges as in the River Waveney valley and the Broads in East Anglia and by the Hampshire Avon (eg Bistern Warren, New Forest, **Appendix 1**).
- Freely draining sands and shingles along the coast on shingle structures, the rear of dune systems and in grazing marshes (eg Dungeness SSSI, **Appendix 1**).
- Cliff top grassland in the south-west of England (see **Appendix 1**).
- Old gravel workings and mine waste tips, as in the Forest of Dean

Ancient, enclosed landscapes generally have very little parched acid grassland, but it sometimes occurs here with neutral and wet grassland (eg Hurcott Pasture SSSI, May Hill SSSI, **Appendix 1**)

4.3.2 *Cornicularia aculeata-Cladonia arbuscula* sub-community grassland (U1a)

This lichen-rich sub-community of U1 is described in Rodwell (1992) as being of very restricted distribution. There is almost certainly less than 1,000ha of the sub-community in England but probably more than 500ha. The largest single stand is 221 ha on the coastal shingle structure of Dungeness, Kent (See **Appendix 1**) (Ferry *et al* 1990), and the only other area where large stands have been found is in Breckland. Smaller stands have been definitely recorded in Cambridgeshire, Hampshire, Humberside, Lincolnshire, Worcestershire and Sussex, on habitats ranging from shingle beaches to inland heathlands. It may also occur as small stands in other counties.

4.3.3 Typical sub-community (U1b)

The Typical sub-community (U1b) of parched acid grassland is the most widespread sub-community in the east of England and is relatively frequent in the north and west including in Shropshire and Northumberland. It is rare to the south-west and is confined to the most freely draining sands in the New Forest (see **Appendix 1**) and in the Poole basin of Dorset. The area covered is difficult to estimate but is likely to be around 4,000ha.

4.3.4 *Erodium cicutarium-Teesdalia nudicaulis* sub community (U1c)

This is a very localised sub-community and easily the rarest sub-community of U1. It seems very unlikely that there is more than 100 ha of this species-rich sub-community in England and this is a matter for considerable concern. It is associated with severe disturbance, including temporary cultivation and heavy grazing pressure. It has been recorded from the Stanford army training area in the Norfolk Breckland, the Greensand heathlands in Hampshire and the edge of the river terraces of the Hampshire Avon. In North Lincolnshire (once south Humberside) it is expanding in area on SSSIs in response to WES scheme management, combined with very high rabbit numbers (see Coversand SSSIs, **Appendix 1**). It is also developing on arable fields that are reverting to grassland under the Countryside Stewardship Scheme (eg the Manton Warren area, **Appendix 1**). Related stands have been recorded from Northumberland and it may occur as fragments in Dorset, Gloucestershire and Staffordshire. These stands may occur on mine waste and on shallow soils over rock in the west.

4.3.5 *Anthoxanthum odoratum-Lotus corniculatus* sub-community (U1d)

On less acidic soils the Anthoxanthum-Lotus sub-community (U1d) of parched acid grassland develops. The largest areas are recorded in Breckland, where it is transitional to calcicolous grass heath (CG7), and the New Forest, where it has developed on heathland formerly cultivated in the 1940s and 1950s (see **Appendix 1** for examples). Beyond these areas it is probably widespread in small stands from Dorset and Kent, and north to Shropshire, Cheshire and Humberside. The sub-community is probably also widespread on coastal shingle. The area covered is very difficult to estimate but is likely to be at least 2,000ha.

4.3.6 *Galium saxatile-Potentilla erecta* sub-community (U1e)

This sub-community is closely related to Deschampsia flexuosa grassland (U2) and Festuca ovina-Agrostis capillaris-Galium saxatile grassland (U4) and probably spreads further north and west than the other sub-communities of U1 (see May Hill SSSI, **Appendix 1**). It is also frequent in the south and east were it will replace Deschampsia flexuosa grassland (U2) if this is heavily grazed. Large areas have been recorded from Breckland and parkland in Kent and Sussex (see Hatch Park SSSI, **Appendix 1**). The total area covered is very difficult to estimate but there could be 3,000 ha.

4.3.7 *Hypochaeris radicata* sub-community (U1f)

Well developed stands of the Hypochaeris radicata sub-community (U1f) are confined to the area south of Shropshire and west of Kent. The sub-community is most extensive in Hampshire where it is part of the habitat mosaic of the New Forest heathlands (see **Appendix 1**). Over 500 ha may occur in the county. Beyond Hampshire the areas are probably quite small and scattered. The sub-community can occur in enclosed pastures along with neutral grassland (eg Hurcott Pasture SSSI, **Appendix 1**). Species-rich examples are found on coastal cliff tops in the south-west (see **Appendix 1**). There is possibly a total of 2,000 ha of the sub-community in England.

4.4 *Deschampsia flexuosa* grassland (U2)

The overall area estimates for Deschampsia flexuosa grassland (U2) are given below, and the county by county estimates are shown **Table 5** and on **Map 19**.

		Estimates (ha)		
Area class	**No. counties**	**Low**	**Medium**	**High**
A	21	210	525	1050
B	4	200	300	400
C	6	600	1500	3000
D	1	500	750	1000
E	0	0	0	0
Totals	**32**	**1510**	**3075**	**5450**

The overall estimates range between 1,500-5,500ha, with the true total more likely to be between 3,000-5,500ha of U2 in the lowlands of England.

Only Surrey was estimated as having more than 500ha. Between 100 and 500ha were estimated for Cumbria, Leicestershire, Norfolk, Nottinghamshire, Staffordshire, and Suffolk. Beyond these counties U2 grassland is found in the lowlands only in small amounts.

U2 is mainly found in association with heath (H communities). *Deschampsia flexuosa* has a reputation for being an aggressive invader of heath. To gain an indication of the extent of this problem, EN Local Teams were asked whether this invasion was a serious problem in their area. The problem was considered serious in only a few heathland areas, with Surrey and Nottinghamshire standing out. In many other areas *Deschampsia flexuosa* is not regarded as a problem. *Deschampsia flexuosa* has been found to be very sensitive to cattle and pony grazing in Hampshire. The grass is not especially aggressive here, even on ungrazed heaths. In Breckland, sheep grazing has been found to adequately control *Deschampsia flexuosa*.

The divergence of opinion on the status of this grass reflects genuine differences. There is marked difference between the relatively low amounts of *Deschampsia flexuosa* on the Hampshire and Sussex heathlands, and the more extensive areas on the Surrey heathlands. Nitrogen pollution may be exacerbating the effects of the cessation of grazing on heathland, but the underlying cause of the increase in *Deschampsia flexuosa* is presumably the lack of grazing. The sensitivity of the grass to cattle, pony and rabbit grazing implies that many U2 grasslands in the lowlands may be recent and that they were not an ancient component of the heathlands and grass heaths (see Lakenheath Warren SSSI, **Appendix 1**).

The lowland sub-community, Festuca ovina-Agrostis capillaris sub-community (U2a) appears to pred-dominate throughout the lowlands, with the Vaccinium myrtillus sub-community (U2b) increasingly replacing it in the upland fringes.

4.5 *Agrostis curtisii* grassland (U3)

The overall area estimates for Agrostis curtisii grassland (U3) are given below, and the county by county estimates are shown in **Table 5** and on **Map 20**.

		Estimates (ha)		
Area class	**No. counties**	**Low**	**Medium**	**High**
A	3	30	75	150
B	2	100	150	200
C	1	100	250	500
D	0	0	0	0
E	1	1000	1500	2000
Totals	**7**	**1230**	**1975**	**2850**

The estimates range between 1,000-3,000ha with the true total more likely to be between 2,000-3,000ha. Only Hampshire was estimated as having over 1,000ha of this community, whilst Cornwall is considered as supporting between 100-500ha. Between 50 to 100ha were estimated for Dorset and Somerset and less than 50ha from Devon, the Isle of Wight and Surrey. It is probably extinct in Wiltshire due to the destruction of heathland in the 1980s.

The south-western distribution of this grassland is to be expected, given the distribution of *Agrostis curtisii* (**Map 12**). In the south-west, U3 grassland is extensive but is largely confined to upland moors. It is probably quite distinct from the lowland type found in Hampshire. *Agrostis curtisii* is very much a grass of unenclosed rough grazings and is rarely recorded within enclosed landscapes. Only 1.7ha of U3 was recorded out of 340.2ha of acid grassland recorded from enclosed land in Exmoor (Butcher & Stewart, 1990). In the New Forest, U3 probably occurs in situations where either Festuca-Agrostis-Galium grassland (U4) or Festuca-Agrostis-Rumex grassland Galium-Potentilla sub-community (U1e) would occur elsewhere in the country (see New Forest example, **Appendix 1**).

Difficulties were reported by Local Teams in distinguishing Agrostis curtisii grassland from regenerating, recently burned, heath (Ulex gallii-Agrostis curtisii heath, H4) in the uplands of the south west. The Ulex gallii-Agrostis curtisii heath, Festuca ovina sub-community (H4b) includes many grassland species and there is little floristic difference between this and U3, other than in the proportion of dwarf shrubs.

The problem is much less marked in the New Forest where Ulex minor-Agrostis curtisii heath, H3, and U3 occur. Here U3 is quite distinct due to in the presence of species such as *Agrostis capillaris* and *Danthonia decumbens*. The undescribed herb-rich heath that occurs in the New Forest is related to Calluna vulgaris-Ulex minor heath (H2) and Festuca-Agrostis-Rumex grassland, Anthoxanthum-Lotus sub-community (U1d) and usually lacks *Agrostis curtisii*.

4.6 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland (U4)

The overall area estimates for Festuca-Agrostis-Galium grassland (U4) are given below, and the county by county estimates are shown in **Table 5** and on **Map 21**.

		Estimates (ha)		
Area class	**No. counties**	**Low**	**Medium**	**High**
A	20	200	500	1000
B	3	150	225	300
C	6	600	1500	3000
D	1	500	750	1000
E	0	0	0	0
Totals	**30**	**1450**	**2975**	**5300**

The estimates range between 1,500-5,000ha with the true total more likely to be between 3,000 and 5,000ha. Only Cumbria was estimated as having over 500ha of this community in the lowlands, whilst between 100 and 500ha were estimated for Cornwall, Devon, Dorset, North East England, Shropshire and Somerset. Smaller areas are estimated from the rest of England with amounts declining in counties to the south and east. None has been recorded from several counties, particularly in the extreme east and south, eg Suffolk and the Isle of Wight. This distribution relates to the moisture deficit factor (**Map 18**). In contrast to U1, U4 is commonest where the moisture defecit is less than 100mm. U4 is extensive in the uplands and is frequent in the upland fringes and lowland areas close to the uplands. *Viola lutea* is an upland plant that is generally faithful to U4 grassland. **Map 13** shows its distribution, and by association the distribuion of upland U4.

The exact distribution of moist acid grassland (U4) in the lowlands is not clear as it appears to have been much over-recorded. Many stands recorded as U4 in fact contain characteristic U1 species such as *Rumex acetosella* and *Aira praecox*, and would fit better into NVC community Festuca-Agrostis-Rumex grassland, Galium-Potentilla sub-community (U1e). Mis-classification may be the result of an ambiguous dichotomy in the key to calcifugous grassland and montane communities in Rodwell (1992). In dichotomy 5 *Galium saxatile* and *Potentilla erecta* are described as being of restricted occurrence in U1 and frequent in U4, but the two species are actually preferentials in U1e,with constancies exceeding 40%. Stands resembling U4 also develop directly from U1 on the cessation of grazing as the dense sward of grasses that results smothers the distinctive herbs, mosses and lichens of U1.

In west Dorset U4 has replaced heathland complexes of Ulex gallii-Agrostis curtisii heath (H4), Agrostis curtisii grassland (U3) and Festuca-Agrostis-Rumex grassland (U1) after attempts at cultivation of the heathland. In the New Forest heathlands, Agrostis curtisii grassland (U3) dominate the damper acid brown earths on which U4 would be expected elsewhere. U4 does occur occasionally in enclosed grasslands in the lowlands (eg North Poorton, **Appendix 1**).

In drier lowland areas good examples of U4 do occur. These are usually restricted to acid, water-retentive, clayey soils, which are not so poorly drained that wet acid grassland can develop. Examples have been recorded from Buckinghamshire and in the ancient parkland of Windsor Forest (see **Appendix 1**). U4 also occurs in glades within the pasture woodlands of the New Forest, where shade protects the sward from parching. Pasture woodland glades may be a characteristic lowland habitat of the community. It can also be found on Clay-with-Flints and other acidic, fine textured, superficials over chalk and limestone (see Burnthouse Down, **Appendix 1**), but mis-identification of U1 as U4 has sometimes occurred in these situations.

4.6 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland (U4)

The overall area estimates for Festuca-Agrostis-Galium grassland (U4) are given below, and the county by county estimates are shown in **Table 5** and on **Map 21**.

		Estimates (ha)		
Area class	**No. counties**	**Low**	**Medium**	**High**
A	20	200	500	1000
B	3	150	225	300
C	6	600	1500	3000
D	1	500	750	1000
E	0	0	0	0
Totals	**30**	**1450**	**2975**	**5300**

The estimates range between 1,500-5,000ha with the true total more likely to be between 3,000 and 5,000ha. Only Cumbria was estimated as having over 500ha of this community in the lowlands, whilst between 100 and 500ha were estimated for Cornwall, Devon, Dorset, North East England, Shropshire and Somerset. Smaller areas are estimated from the rest of England with amounts declining in counties to the south and east. None has been recorded from several counties, particularly in the extreme east and south, eg Suffolk and the Isle of Wight. This distribution relates to the moisture deficit factor (**Map 18**). In contrast to U1, U4 is commonest where the moisture defecit is less than 100mm. U4 is extensive in the uplands and is frequent in the upland fringes and lowland areas close to the uplands. *Viola lutea* is an upland plant that is generally faithful to U4 grassland. **Map 13** shows its distribution, and by association the distribuion of upland U4.

The exact distribution of moist acid grassland (U4) in the lowlands is not clear as it appears to have been much over-recorded. Many stands recorded as U4 in fact contain characteristic U1 species such as *Rumex acetosella* and *Aira praecox*, and would fit better into NVC community Festuca-Agrostis-Rumex grassland, Galium-Potentilla sub-community (U1e). Mis-classification may be the result of an ambiguous dichotomy in the key to calcifugous grassland and montane communities in Rodwell (1992). In dichotomy 5 *Galium saxatile* and *Potentilla erecta* are described as being of restricted occurrence in U1 and frequent in U4, but the two species are actually preferentials in U1e,with constancies exceeding 40%. Stands resembling U4 also develop directly from U1 on the cessation of grazing as the dense sward of grasses that results smothers the distinctive herbs, mosses and lichens of U1.

In west Dorset U4 has replaced heathland complexes of Ulex gallii-Agrostis curtisii heath (H4), Agrostis curtisii grassland (U3) and Festuca-Agrostis-Rumex grassland (U1) after attempts at cultivation of the heathland. In the New Forest heathlands, Agrostis curtisii grassland (U3) dominate the damper acid brown earths on which U4 would be expected elsewhere. U4 does occur occasionally in enclosed grasslands in the lowlands (eg North Poorton, **Appendix 1**).

In drier lowland areas good examples of U4 do occur. These are usually restricted to acid, water-retentive, clayey soils, which are not so poorly drained that wet acid grassland can develop. Examples have been recorded from Buckinghamshire and in the ancient parkland of Windsor Forest (see **Appendix 1**). U4 also occurs in glades within the pasture woodlands of the New Forest, where shade protects the sward from parching. Pasture woodland glades may be a characteristic lowland habitat of the community. It can also be found on Clay-with-Flints and other acidic, fine textured, superficials over chalk and limestone (see Burnthouse Down, **Appendix 1**), but mis-identification of U1 as U4 has sometimes occurred in these situations.

In the lowlands the two main sub-communities of Festuca-Agrostis-Galium grassland (U4) are the Typical sub-community (U4a) and the Holcus lanatus-Trifolium repens sub-community (U4b). The latter tends to be found in semi-improved grassland. There are probably less than 500ha and 1000ha respectively of these sub-communities in the lowlands. The extent of the Lathyrus montanus-Stachys betonica sub-community (U4c) is unclear. The vegetation described by the NVC is a distinctive transition between calcicolous grassland and acid grassland, found in the White Peak in Derbyshire and Staffordshire. There is, however, a similar transition between Cynosurus-Centaurea grassland, Danthonia sub-community (MG5c) and more typical U4, which is particularly found on the Coal Measures across England and has been noted in Dorset (Porley, 1992) and Gloucestershire (Doe 1995). U4c has also been recorded from Scotland (Cooper and MacKintosh 1996). It is not clear how to treat such stands, as they do not seem to be really comparable with U4c as described by Rodwell (1992). The Vaccinium-Deschampsia sub-community (U4e) and to a lesser extent, the Luzula-Rhytidiadelphus sub-community (U4f) are recorded occasionally as the upland fringe is approached. Probably there is less than 50ha of either sub-community in the lowlands.

4.7 *Nardus stricta-Galium saxatile* grassland (U5)

The overall area estimates for Nardus-Galium grassland (U5) are given below, and county by county estimates are shown in **Table 5**:

		Estimates (ha)		
Area class	**No. counties**	**Low**	**Medium**	**High**
A	11	110	275	550
B	0	0	0	0
C	0	0	0	0
D	0	0	0	0
E	0	0	0	0
Totals	**11**	**110**	**275**	**550**

No extensive areas of lowland Nardus-Galium grassland (U5) were identified. It was most frequently recorded from Gloucestershire, West Midlands and Nottinghamshire northwards. South of this, *Nardus* is more commonly found in other communities. It is a frequent component of wet heath (M16) and wet acid grassland (M24c and M25b) and occurs in neutral grassland (MG5c). In the south, it can even be found in parched acid grassland (U1). However, U5 grassland can occur in the south, as it has been observed in Norfolk by the author. It has been recorded in heathland and enclosed landscapes. It is likely to be much more common in the upland fringe than in the lowlands.

4.8 *Juncus squarrosus-Festuca ovina* grassland (U6)

This is a strongly upland community of wet soils. In the lowlands *Juncus squarrosus* is largely a species of wet heath and few stands have been recorded as U6. Small areas of U6 were noted in the Humberside Coversands (Wigginton 1990) and at the back of a dune system in Cumbria (Radley, 1994) but neither was typical, and were related to wet heath rather than acid grassland. The areas recorded cover about 25ha in total.

4.9 *Carex arenaria* communities

The occurrence of *Carex arenaria* in acid grassland in inland parts of England is a feature of considerable interest. It is found in heathland landscapes on loose, well-drained, sands in Breckland, the Greensand heaths of Norfolk and the western Weald, the Coversand of Lincolnshire, Humberside, Nottinghamshsire and South Yorkshire, sandy parts of the Dorset heaths and on river terraces by the Hampshire Avon. In Breckland it is associated with areas of wind blown sand, but in other areas it simply marks out areas of sharply draining sand, although it occurs on what appears to be ancient blow- outs and dunes by the Hampshire Avon. **Map 11** shows the distribution of *Carex arenaria* and the potential distribution of *Carex arenaria* communities.

Carex arenaria can occur in U1, for instance in Breckland. When grazing levels decline *Carex arenaria* can increase in height and dominate in a rank, species-poor, community which has been classified as Carex arenaria dune (SD10) (see Lakenheath Warren SSSI **Appendix 1**). A very approximate overall estimation of the area of SD10 is given below and county by county estimates are shown in **Table 5.**

***Carex arenaria* community SD10**

		Estimates (ha)		
Area class	**No. counties**	**Low**	**Medium**	**High**
A	5	50	125	250
B	2	100	150	200
C	0	0	0	0
D	0	0	0	0
E	0	0	0	0
Totals	**7**	**150**	**275**	**450**

As far as can be determined, there is probably less than 500ha and more than 100ha of rank *Carex arenaria* vegetation on inland heathlands. Most of this is found in Breckland, with small stands in Hampshire, Humberside, Lincolnshire, Nottinghamshire and Surrey. The area of this community is likely to have increased as grazing has declined, and like *Deschampsia flexuosa* grassland, SD10 may not have existed when Breckland was heavily grazed. The area of SD10 is likely to decline if grazing is restored, to be replaced by more diverse U1 and SD11 communities.

Inland mobile dunes observed by the author at Risby Warren in the North Lincolnshire Coversands Natural Area have a very distinctive pioneer community of open *Carex arenaria,* combined with *Poa annua* and tall grassland species such as *Cirsium arvense* and *Senecio jacobaea* growing through from the buried sward below. This pioneer vegetation contrasts with stands of short, open, lichen-dominated vegetation with much *Carex arenaria* which are classified as SD11, Carex arenaria-Cornicularia aculeata community. Both are very rare communities in inland areas. Estimates for SD11 are given below:

***Carex arenaria-Coelocaulon aculeatum* community (SD11)**

		Estimates (ha)		
Area class	**No. counties**	**Low**	**Medium**	**High**
A	6	60	150	300
B	0	0	0	0
C	0	0	0	0
D	0	0	0	0
E	0	0	0	0
Totals	**6**	**60**	**150**	**300**

Most of the inland stands of SD11 are in Breckland but small stands have been noted in Hampshire, Humberside, Lincolnshire and Surrey. The community may have a much closer association with inland sand dunes or recently disturbed sand than either SD10 or U1 which contains *Carex arenaria*. The Hampshire stand of SD11 was recorded from a bank of bulldozed sand forming an artificial dune on a heathland firing range (Sanderson & Stanbury, 1996). About 250ha of SD11 has been recorded from coastal dunes mainly in East Anglia and Cumbria (Radley, 1994)

4.10 *Pteridium aquilinum* communities

Bracken is often found in association with acid grassland, but during the consultation, enquiries were made as to the presence of herb-rich Bracken or Bracken harbouring rare butterflies. These stands have been categorised as 'U20r' in **Table 5**. This habitat was noted in Cornwall, Cumbria, Devon, Dorset, Hampshire, Hereford and Worcester, the Isle of Wight and Somerset. The richest examples for rare and local plant species appears to be those of the New Forest (See **Appendix 1**) but those of the west are richer in butterflies. It is difficult to estimate the extent of the habitat, there may be between 100 to 500ha.

5. Nature conservation interest of lowland acid grassland: flora

5.1 Introduction

Acid grasslands have a reputation as species-poor grasslands but in fact many are species-rich, especially in uncommon species. A survey of an acid grassland complex in the heathlands of Woolmer Forest, Hampshire (Sanderson & Stanbury, 1996) recorded 135 species including 101 vascular plants, 15 bryophytes and 19 lichens from 7.6ha of grassland composed of U1a, U1b, U1c, U1d, SD10 and SD11. Four nationally scarce vascular plant species were recorded and the richest quadrat (U1c) included 32 species in $4m^2$. Other examples given in **Appendix 1** include 38 species in a $4m^2$ quadrat placed in U1c in Risby Warren, North Lincolnshire and 35 species in a $4m^2$ quadrat placed in U1d/f in the New Forest. Surprisingly, the grasslands with the highest number of species per quadrat sample in the NVC are not lowland calcicolous or neutral grasslands, but U20a (Pteridium aquilinum-Galium saxatile: Anthoxanthum oderatum sub-community) and U4a (Typical sub-community) (Rodwell 1992). Clearly there can be very species-poor examples of these sub-communities (5 and 7 species respectively in the poorest quadrats in the NVC tables), as there can be of calcicolous and neutral grasslands, eg seven species in the poorest quadrats of CG2a Festuca ovina-Avenula pratensis grassland, Cirsium acaule-Asperula cynanchica sub-community).

The flora of acid grasslands has undergone very severe declines in Britain. **Maps 3** and **4** illustrate the dramatic losses among a group of 25 species, of which 20 are nationally rare or scarce. **Maps 5** to **10** show great declines in species of two associated habitats in acid grassland landscapes, namely ephemeral ponds and disturbed sandy soils in ungrazed situations, such as low-intensity arable land and waysides. The general assumption that acid grasslands are species-poor appears to be associated with the impoverished condition of many acid grasslands in the lowlands, due to the widespread collapse of grazing and other management associated with extensive pastoral systems.

A case study in Dorset (Byfield & Pearman 1996), shows that acid grassland species in heathland landscapes have suffered exceptionally serious declines which are far more severe than the loss of heathland habitat. It was found that 35% of heathland samples surveyed in the 1930's by Professor Good and re-surveyed over the period 1990 to 1993 had been destroyed. However, 11 species included by this review in the list of faithful lowland acid grassland (**Table 1**) had been lost from 88% of the samples in which they had been found in the 1930's. This contrasts with losses of 41% and 50% for wet heath and mire species found in the 1930's set of samples. The cessation of grazing was thought to be the primary reason for these declines. No similar decline has occurred in the nearby New Forest where traditional extensive grazing has survived. Declines in the flora of Breckland have also been attributed to the decline in grazing pressure (Lambley 1994c).

As well as evaluating the importance of the flora of acid grasslands, the following section also describes the national and regional distribution of the vascular plants identified as faithful to acid grassland (**Table 1**) and proposes a potential way to use an indicator list of characteristic acid grassland species for floristic assessments of acid grasslands.

5.2 Vascular plants

5.2.1 Rare and scarce plants

Lowland acid grasslands, especially parched acid grasslands (U1), are rich in rare and declining vascular plants. **Tables 1** and **2** list 17 nationally rare and 22 nationally scarce vascular plant species which can occur in acid grasslands. Most of the species in **Table 1**, which includes 8 nationally rare and 13 nationally scarce species, have their main habitat in acid grasslands. These totals indicate that lowland acid grassland is second only to calcicolous grassland as a grassland habitat for rare and declining species in the English lowlands, and is certainly much richer than either neutral grasslands or base-rich and acid fen meadows. This richness has often been overlooked in the past, perhaps because many acid grassland species have been 'annexed' to other habitats in which they are also found and acid grasslands then defined as species-poor by default. For example many lowland acid grassland species have been described as coastal, although they have concentrations away from coastal habitats. For instance, the sand dune species coincidence map in Stewart *et al* (1994) shows the New Forest as more significant than the Merseyside coastal dunes for 'sand dune species'.

The literature search, especially of local floras, emphasised the local richness of parched acid grassland (Festuca-Agrostis-Rumex grassland) in declining and restricted species of vascular plants, especially U1a, U1b, U1c, U1d and U1f. The Potentilla-Galium sub-community (U1e), appears generally to be much less rich. All the species recorded as either faithful lowland acid grassland species (**Table 1**) or locally characteristic species (**Table 2**) have been recorded at some time in U1 communities.

In contrast the vascular plant diversity of Deschampsia flexuosa grassland (U2) appears to be low, with few references to rare or scarce species. The exception is Sherwood Forest, where outlying colonies of the southern *Ulex minor* are confined to *Deschampsia flexuosa* grass heath.

Agrostis curtisii grassland (U3) stands vary in floristic diversity. Many stands are quite species-poor but dry stands in Dorset and Hampshire share many species with species-rich parched acid grasslands (U1) and the community supports some species which are more typical of U3 grassland than U1, such as *Carex montana*, *Viola lactea* (both nationally scarce)and *Euphrasia vigursii* (nationally rare).

Festuca-Agrostis-Galium grassland, U4, generally has a limited vascular plant flora. During the consultations and literature search special effort was made to discover any special vascular plant interest for this type of grassland. Little was found and the few species mentioned were essentially upland species such as *Viola lutea* (**Map 13**) in Shropshire (Sinker *et al*, 1985) and *Pseudorchis albida* in the Lake District (Ian Slater, EN, pers. comm.).

Significant associated habitats in acid grassland landscapes include ephemeral ponds in heavily grazed acid grassland. These ponds are still frequent in the New Forest area but have been lost in most other areas. They are found within mosaics of acid grasslands (U1f and U3) and neutral grassland (MG6b) and their flora includes the nationally rare species *Galium constrictum*, *Ludwigia palustris*, *Pulicaria vulgaris* and the nationally scarce species *Cicendia filiformis*, *Pilularia globulifera*, *Limosella aquatica* and *Illecebrum verticillatum* (Chatters, 1996).

The meres of Breckland with their varying water levels are found within grass heaths (Trist, 1979), and also support species of interest including the local *Alopecurus aequalis* and *Rumex maritimus* and the nationally rare *Alisma gramineum*. One of the ephemeral pond plant communities that contain these rare and scarce plants may equate to OV35, Lythrum portula-Ranunculus flammula community (Rodwell, in prep). These ephemeral pond habitats increase the totals of nationally rare species associated with acid grassland to 20 species and nationally scarce species to 22 species.

Very heavily disturbed or cultivated sandy soils in ungrazed situations also support a number of declining species. These were once typical of cultivated and wayside situations within heathland and grass heath landscapes, but were rarely found in grazed areas. Characteristic species include the nationally rare Breckland Speedwells *Veronica triphyllos* and *Veronica praecox*, as well as the nationally scarce species *Arabis glabra*, *Apera spica-venti*, *Medicago sativa falcata* and *Silene gallica*. Recent surveys indicate that *Filago lutescens* (Rich 1995 and 1996 and Rich & Davis 1996), another nationally rare species of disturbed ground, is more typical of early succession and U1 grassland than arable land and is tolerant of grazing. Species of disturbed sandy soils were once found widely in the east of England within light acid soil areas but are now largely confined to Breckland.

Unlike ephemeral ponds such arable or wayside habitats are now much less of an integral part of acid grasslands due to the disappearance of the low-intensity arable farming associated with extensive grazing of heathland and grass heath.

5.2.2 National and regional distribution of lowland acid grassland species

As part of the review, a list of vascular plants generally faithful to acid grassland was developed (**Table 1**). As well as indicating the possible distribution of acid grassland (see Section 3.3), the numbers of these species on a county and Natural Area basis were worked out to give an idea of the relative significance of different parts of England for these species. First, the broad national pattern is described and then a summary of county information. Further detail is available in **Volume II**. The species listed in **Table 1** can be divided into four groups in terms of their national distributions:

- A small group of generally distributed species: *Filago minima, Moenchia erecta, Ornithopus perpusillus, Stellaria pallida, Teesdalia nudicaulis, Trifolium scabrum* and *T. striatum.*
- Species with an eastern tendency in their distribution: *Apera interrupta, Corynephorus canescens, Festuca longifolia, Vulpia ciliata ambigua, Crassula tillaea, Dianthus deltoides, Herniaria glabra, Hypochaeris glabra, Medicago minima, Potentilla argentea, Seleranthus perennis, Silene conica, Thymus serpyllum, Trifolium subterraneum, Veronica verna* and *Vicia lathyroides.* The rarest tend to be confined to East Anglia but the more widespread species are found with increasing rarity into the south west. They can also reach far into the north but spread further into the north east than the north west. At the north of their range many species are purely coastal.
- Species with a southern or south western tendency: *Chamaemelum nobile, Gladiolus, illyricus, Lotus angustissimus, Lotus subbiflorus, Trifolium glomeratum, T. ornithopodioides, T. suffocatum* and *Viola lactea.* These species are largely restricted to the south of the country; the rarer species are only recorded south of the Thames to Bristol line whereas the more widespread species extend towards the East Anglian coast and, rarely, into the Midlands.

Two species have somewhat disjunct distributions. *Sagina subulata* has an largely south western distribution in England but it is widespread in Scotland and survives in Northumberland in spite of it absence from much of eastern and northern England. *Erodium maritimum* is found mainly in western coastal areas in England and Wales but once had some inland records from the Welsh borders.

The county and Natural Area distribution of these 33 species are shown in **Table 6** and **7** and on **Map 22**. The data shown were derived primarily from local floras. The level of sub-division of areas depended on the detail available. In some cases information is presented only at county level, while it was possible to derive Natural Area species totals in other cases. The areas selected for display cover all the areas of England that are of significance for the 33 species.

Table 7 ranks the areas by floristic diversity. The adjacent areas of the western Wealden Greensand heaths in Surrey, Hampshire and Sussex (NA70) have been combined in this table, as have the London Basin heaths south west of London (NA66) and the parts of Dungeness in Kent and Sussex (NA71). **Map 22** shows the areas in **Table 7** that can be defined as part of, or all of, individual Natural Areas.

The richest three areas, with over 20 extant acid grassland species, are Breckland, the Dorset Heaths and the New Forest. Not unexpectedly, given the national distribution of the species (described above), the richest areas are found south of the Wash to Bristol line, and all areas with 15 or more characteristic species are concentrated here. North of this line, only three areas have between 10-14 characteristic species; the heaths around Kidderminster in the West Midlands, the Northumbian Whin

Sill and the Coversand area of Lincolnshire, Nottinghamshire and Humberside. Some areas, such as west Dorset, have very few of the species, despite having relatively large areas of acid grassland. Here, acid grassland is often U3 or U4 and thus has a poor representation of the 33 species, which are primarily found in U1.

Table 6 also gives the ratio between extant species and the total number recorded. The general trend of these ratios is for the proportion of remaining species to be lowest in areas which were initially poorer. Most of these have small areas of grassland and the pattern of extinction probably reflects greater vulnerability of smaller areas to habitat loss and abandonment of management. Areas that originally had rich floras but have lost a high proportion are likely to be areas where habitat loss has been especially severe. These include the Devon Redlands, Cambridgeshire, North Norfolk, north-east Essex and the Midvale Ridge in Oxfordshire.

5.3 Bryophytes

Acid grasslands, especially heavily grazed, parched, U1 and moist acid (U4) grasslands, can have a very high cover of mosses, but these are nearly all widespread species. The composition of these moss mats varies between U1 and U4 grasslands, *Rhytidiadelphus squarrosus* and *Pseudoscleropodium purum* are much more typical of moist acid grassland (U4) and are also found in low productivity neutral grasslands. Species partial to parched acid grasslands (U1) include *Brachythecium albicans*, *Polytrichum juniperinum* and *Polytrichum piliferum* on the more acid soils and *Hypnum lacunosum tectorum* on more base-enriched substrates. Shared species include *Hypnum jutlandicum* and *Dicranum scoparium*.

As well as these species there are a few specialist species, but these are few in number when compared to vascular plants. Some are species which are common in the uplands but are local or scarce in the lowlands and here are confined to parched acid grassland. Examples are *Racomitrium canescens* agg (usually *R. elongatum* Frisvoll) and the liverwort *Ptilidium ciliare*. Another local species, which is largely confined to parched acid grassland where it occurs away from the coast, is the sand dune moss *Tortula ruralis ruraliformis*. A few local southern species are shared between acid and calcicolous grassland, such as *Sceleopdium touretii* in the New Forest and *Rhynchostegium megapolitanum* in the Sussex Greensand heathlands (Rose, *et al* 1991). *Campylopus polytrichoides* is a very localised moss of open parched rocky grasslands on cliff tops in the south west. The list of associated species in Blockeel (1992) suggests that U1f is probably its main habitat.

One nationally rare species, *Leptodontium gemmascens*, has been recorded from lowland acid grasslands. Originally this species was only known from old roof thatch in southern England but has recently been found in acid grasslands in southern England. Presumably grassland is the original habitat. The species has been found on the bases of grass tussocks and on rabbit droppings (Blockeel, 1992). It is likely to be under- recorded, and may be more widespread in lowland heathland habitats. In Wales the nationally rare *Bartramia stricta* grows in stands akin to U1 on dolerite outcrops.

Ephemeral ponds in acid grasslands and grass heaths can also harbour rare and local bryophytes. The meres of Breckland support the nationally rare moss *Physcomitrium eurystomum*, while the nationally scarce liverwort *Fossombronia foveolata* occurs in ephemeral ponds in the New Forest. Ephemeral ponds on Gorley Common in the New Forest have been recorded as supporting large populations of the mainly upland *Bryum alpinum* (Sanderson, 1997b).

5.4 Lichens

Lichens are generally poorly represented in moist acid grassland (U4) but some are usually present in the drier types of *Deschampsia flexuosa* (U2) and *Agrostis curtisii* (U3) grasslands. A notable record for U2 is the northern lichen *Icmadophila ericetorum*, found in Sherwood Forest (Soden 1991) and Charnwood Forest (N. Sanderson, pers. obs.).

Parched acid grassland (U1) is the richest type for lichens. The most typical species are lichens of mildly acidic situations, such as *Cladonia furcata* and *Cladonia rangiformis* and occasionally the local species *Peltigera canina*, *Cladonia cariosa*, *Cladonia foliacea*, and *Diploschistes muscorum*. The first two of these local species are listed as nationally scarce by Hodgetts (1992).

The richest sub-community is U1a (Cornicularia aculeata-Cladonia arbuscula sub-community). The lichen flora of this sub-community is similar to that of dry heath but tends to have a higher cover of *Cladonia furcata* than is typical of dry heaths and *Cladonia foliacea* is especially characteristic. *Cladonia arbuscula* is commoner in grassland communities than heath in the lowlands because it appears to prefer short, open, communities. It is still common where dry heath has this structure, for instance heavily grazed H2a in the New Forest (1997b), but has died out in the unmanaged dry heaths of Sussex (Rose, 1992).

Lichen-rich acid grassland and heath lack very rare species, unlike open calcicolous grasslands (CG7c and CG1), but the lichen flora of dry heath and U1 is a distinctive feature of considerable importance for biodiversity. The following examples give an indication of the range in species richness. Some stands have a high cover of lichens but a low diversity of species, often with the bulky *Cladonia portentosa* totally dominating. Other stands have both a high cover of lichens and a high diversity of species. In areas acknowledged as being important for their lichen flora, EPR recorded the totals given below, which are compared with data from Breckland surveys (Smith & James 1995 and Smith 1996).

Site	Habitat	No. of lichens in stand	Mean no. lichens per quadrat of U1a
New Forest (Sanderson 1997b)			
Hyde Common	H2a, H3c, U1f, U1b	25	NA
Gorley Common	H2a, H3c, U1f, U1b	25	NA
Woolmer Forest (Sanderson & Colebourn 1993 and Sanderson & Stanbury 1996)			
Kingsley Common	H1b, U1b	30	NA
Woolmer Road	U1a	17	0.6
Woolmer Pond	U1a	21	9.8
North Lincolnshire Coversand (this review)			
Manton Warren, South	H11a, U1a, U1b, U1c, SD11	22	7.5
Suffolk Breckland (Smith & James 1995 and Smith 1996)			
8 separate sites	U1a	1-3 (mean 1.9)	1.6

Lichen-rich stands in heath and acid grassland can have between 15 and 30 species of lichen recorded, with high average numbers of species recorded per $4m^2$ quadrats. Similar species rich stands are recorded from Dungeness in Kent (Ferry *et al*, 1990) but U1a stands surveyed recently from Breckland are remarkably species-poor. This paucity may be part of the general decline in the quality of Breckland habitats, mainly due to the decline of grazing and disturbance (Lambley 1994d). Pollution has been suggested as a factor contributing to the decline but the richness of the lichen flora seen on Manton Warren by EPR during this review do not support this idea, as North Lincolnshire apparently suffers from high levels of air pollution. The site is, however, much more heavily grazed by rabbits than the sites surveyed in Breckland, to judge by the pictures in Smith & James (1995) and Smith (1996), and it may be that the open ground and lack of competition from vascular plants are more significant in favouring a rich lichen flora.

5.5 Fungi

Little has been published on the conservation value of the fungi of lowland acid grassland but there are indications from recent work that moist, low productivity acid grasslands (U4) and some neutral grasslands (MG6b) can be especially rich in declining fungi. These grasslands are usually rather poor in vascular plant species but are typically old, short grasslands in habitats such as lawns of old country houses, parklands, glades in pasture woodlands and upland fringe pastures (Rotheroe 1995, Marren 1998). Marren (1998) reports the extreme sensitivity of the scarcer *Hygrocybe* species to nutrient addition, eg chemical fertilizers. An area of grassland in the Forest of Dean, which appears to be a surviving, ancient forest, lawn, consisting of a mosaic of U1, U4 and U5, is currently the richest known site for *Hygrocybe* (waxcaps) species in Britain, with 32 species recorded. It is also rich in *Entoloma* species with 17 species recorded (Rotheroe, 1995 and EN files). Rotheroe *et al* (1996) also mentions 3 ha of acid grassland on a farm near Clitheroe, Lancashire with at least 29 *Hygrocybe* species and 21 *Entoloma* species. Short acidic grassland associated with ancient trees in parklands and pasture woodlands can also be rich in local or rare mycorrhizal fungi that are associated with trees, eg in Windsor Great Park (T. Green, EN, pers. comm.). Overall, the diverse *Hygrocybe* communities, which include rare and scarce species, that are found in acid grassland habitats, may be of national and even European importance (I. Taylor, EN, pers. comm.). Clearly further work is required to assess acid grassland fungi floras. An important contribution is the on-going waxcap survey by the British Mycological Society (Rotheroe *et al* 1996, Marren 1998).

5.6 A provisional indicator species list for floristic assessment

Although U1 grasslands can be very rich, sometimes they can contain only a few species. Floristic richness is an important factor in assessing the conservation value of these grasslands. The following section describes a provisional indicator list that could potentially assist with these floristic assessments. The lists of generally faithful lowland acid grassland species (**Table 1**) and locally characteristic acid grassland species (**Table 2**) have been used to produce a provisional indicator list for lowland acid grassland (**Table 8**). This could provide a measure of the floristic diversity of stands of acid grassland and be used as an aid to assessing the conservation interest of a given stand.

The England Field Unit of the former Nature Conservancy Council have produced separate indicator lists for calcicolous grassland, mesotrophic and acid grassland (Rowell and Robertson 1994). While the calcicolous and mesotrophic grassland indicator lists are reasonable for assessing quality, the acid grassland list has not been used. It covers rather a wide range of acid grassland communities including wet grassland. A more focussed indicator list for dry acid grassland types is suggested here, and would be of use primarily for U1 grasslands.

A good indicator list of ephemeral pond species is given by Chatters (1996). These species could be regarded as bonus species and added to the acid grassland indictor list.

A few species lists from existing data on acid grasslands were examined to gain an idea of the sorts of totals that could be expected from acid grassland sites. Representative lists were not easy to find as several vegetation surveys had been undertaken in late summer (eg Smith & James 1995, Smith 1996 and Wigginton 1990) and hence could not include full species lists. Full site surveys in Dorset, Hampshire and Surrey, and selected quadrat data from Kent and Shropshire illustrate the range of numbers of indicator species compared to country totals.

County: Site **Landscape (main NVC type)**	**Table 1 Spp**	**Table 2 Spp**	**Table 8 Spp**	**Source**
Dorset : Sandford (SZ99) Heathland enclosure relic (U1f, U1d)	14	16	32	(Sanderson 1995c & unpublished data)
Hampshire: Keyhaven (SU39) Coastal grazing marsh (U1f)	5	7	12	(Sanderson, 1996a)
Hampshire: Test Marshes (SU31) Coastal grazing marsh (U1f)	4	4	8	(Sanderson, 1996b)
Hampshire: Titchfield (SU50) Coastal grazing marsh (U1f/d)	8	7	15	(Norton, 1996)
Hampshire: Woolmer (SU73) Disturbed patches in heathland (U1a, U1b, U1c, SD11)	11	16	28	(Sanderson & Stanbury, 1996)
Hampshire: Bransbury (SU44) Flint gravel in base rich alluvial common (U1d)	0	4	4	(Sanderson, 1996c)
Surrey: Reigate Heath Mown recreation grassland on heathland (U1b, U1d/f)	6	10	16	(Sanderson, 1997c)
Kent: Dungeness (quadrats) Shingle beach (U1a, U1d, U1f)	6	14	20	(Ferry *et al*, 1990)
Shropshire: Earls Hill (SJ40) (quadrats) Dolerite outcrop (U1b)	2	5	7	EN files
Shropshire: The Lump (SO29) (quadrats) Dolerite outcrop (U1f)	4	4	7	EN files
County: Natural Areas				
Hampshire: New Forest	21	39	60	(Brewis *et al*, 1996)
Norfolk & Suffolk: Breckland	24	40	64	(Trist, 1979 & dot maps for lower plants)

In 1997 the author obtained community lists for the following sites as part of the acid grassland review

County: Site **Landscape**	**Table 1 Spp**	**Table 2 Spp**	**Table 8 spp**
N. Lincolnshire: Risby Warren Blown sand grass heath (U1c, SD11)	6	20	26
N. Lincolnshire: Manton Warren Blown sand grass heath (U1a, U1b, U1c, SD11)	4	20	24
Hampshire: Boltons Bench New Forest heathland, ancient settlement green (U1f)	6	11	17
Hampshire: Yew tree Heath New Forest heathland, site of WWII structures (U1 d/f)	6	18	24
Hampshire: Culverley New Forest heathland, site of arable cultivation 1940's (U1 d/f)	3	9	12
Hampshire: Dibden Inclosure New Forest heathland, site of liming & reseeding 1960's (U1 d/f)	3	13	16
Hampshire: Culverly New Forest heathland, ancient acid grassland (U3)	0	1	1
Kent: Hatch Park Deer park (U1d/e, small area U1b, U1a)	3	5	8
Worcestershire: Hurcott Pasture Enclosed grassland (U1f)	2	4	6

In addition a brief examination of the important site of Hartlebury Common in Hereford and Worcestershire produced a count of 13 indicators and more would be likely to be present.

The limited data available suggest that the best U1a, U1b, U1c, U1d and U1f sites, south of Lincolnshire and the Midlands, can be expected to have between 20-30 indicator species, with sites with 10 or more being of high interest. North of this, a lower total would probably be more likely, and sites with more than 5 indicators would probably be regarded as having relatively high interest. Other grassland types, ie U1c, U2, U3 and U4 have a much lower floristic diversity, particularly of vascular plants, and are not easily assessed using this indicator list.

6. Nature conservation interest of lowland acid grasslands: fauna

6.1 Birds

6.1.1 Introduction

The structure and moisture status of grassland is more important than floristic species composition in determining use of the habitat by birds. In the case of dry acid grasslands, the bird fauna is similar to that of other dry grasslands including calcareous grasslands and grass heaths.

Dry grasslands once supported a diverse and abundant avifauna but this drastically diminished in the 19th and 20th centuries. Early losses included the Great Bustard which became extinct due to habitat fragmentation and excessive hunting early in the 19th century. More recently, the dramatic decline of the Stone Curlew, from over 1,000 pairs in the 1940's to just 160 pairs in the mid 1980's, has coincided with the continued decline in both the quality and quantity of dry grassland habitats. Indeed, in those areas where dry grassland survives, the decline in both livestock and rabbit grazing has led to the loss of short grassland which in turn has led to declines of dry grassland birds which require short turf.

In 1992 the JNCC has commissioned a detailed review of the importance of dry grassland for bird conservation in lowland Britain (Dolman, 1992a). A summary of the findings is presented below and up-dated with information supplied by Philip Grice, Ornithologist in English Nature. It should be noted that the importance and extent of acid grasslands which are part of heathland landscapes, especially those in the New Forest, were over-looked, and the report's description of the types and extent of lowland acid grassland in the New Forest needs up-dating. Grassland occupies about 40% of the unwooded, dryer soils on the open heathlands in the New Forest (see **Volume II**, Hampshire county account). As is the case with many plants, the split between a "heathland" bird fauna and a "dry grassland" bird fauna is somewhat artificial. The perception that there are two distinct faunas may have been encouraged by the differentially severe loss of acid grasslands on ungrazed heathlands, thus making them now appear to be a more uniform habitat, whereas in the past they were a mosaic of heathland and grassland. In the following section the term "heathland" refers to this mosaic.

6.1.2 Consevation status and habitats of dry grassland birds

Dolman (1992a) categorised species according to the significance of dry lowland grassland for the maintenance of their population size and range. The summaries below have been divided into the categories described by Dolman and, in addition, the current conservation status of each species according to the Red, Amber and Green Lists of *Birds of Conservation Concern in the UK* (Anon 1996) is given. Species on the Red List have suffered severe declines in population size or range, or are species of global conservation concern. Amber List species are those that have undergone moderate declines, have small population sizes, occupy few sites, or have an unfavourable conservation status in Europe. The Green list covers all the remaining species (Anon 1996).

Species for which lowland dry grassland is critical, or potentially critical, for the future of the British population

- **Stone Curlew** Red List

  The Stone Curlew is a steppic species which reaches the northern limit of its range in England. It is a classic breeding species of extensive acid and calcicolous dry grasslands, especially areas interspersed with arable farmland. The Stone Curlew is the only species considered by Dolman (1992a) to be critically dependent on lowland dry grassland for its survival as a

British breeding bird. Breckland, which includes acid grassland, and the Wessex chalk downlands are the strongholds for this historically declining bird, which has been recovering in recent years. Past records of summer birds on the Greenham Common air base suggests that other extensive acid grasslands could also be used if human disturbance was lower (EPR, 1995). The species has been part of English Nature's Species Recovery Programme since 1995. In 1997 the population was estimated at 192 breeding pairs. Lack of grazing and habitat loss were responsible for a serious decline in birds which nested on grasslands. Arable land is now more widely used than grasslands, but successful nesting is dependent upon the modification of normal farming practices. Birds using tightly grazed, grass heath or downland nest at the highest densities but can suffer from high predation rates in some situations. Preferred nest sites are very short, open swards on stony ground. As well as producing a suitable vegetation structure, grazing animals provide an important food source for dung invertebrates, which in turn are a significant food supply for the Stone Curlew. The recovery has resulted from a combinaton of intensive species protection and management work by project teams funded by English Nature and the Royal Society for the Protection of Birds in the two strongholds of the species, together with improved management of Breckland grass heaths in Environmentally Sensitive Area agreements.

- **Woodlark** Red List

  This declining species breeds in areas of bare ground and short grass mixed with long grass, bracken or heather. Historically, acid grassland was used as part of this mosaic but the proportion of Woodlarks breeding on heathland has declined. As is the case for the Nightjar it has been largely lost from the Breckland grass heaths but survives in clear felled and replanted conifer plantations. However, it survives as a grassland species in some areas, including the New Forest, where most pairs breed on acid grasslands. The New Forest population does not use clear fell areas. In the New Forest Woodlark may be negatively affected by recreation pressure but the population has increased from 60-100 pairs in the early 1990's (Clark & Eyre, 1993) to between 177-181 in 1997. A national survey in 1997 conducted by the RSPB, the British Trust for Ornithology and EN, found that the breeding Woodlark population had increased dramatically from around 250 territories in 1986 to as many as 1,550 in 1997. Improved heathland management, as well as habitat availability in plantations has contributed to the increase. Dry grassland may again become critical for the survival of the national population when conifer plantations mature into unsuitable habitat.

Species for which lowland dry grassland is critical, or potentially critical, for the maintenance of the size or range of the British breeding population or wintering numbers

- **Cirl Bunting** Red List

  This species is now virtually restricted to south Devon and Cornwall. It uses a variety of habitats including coastal scrub, unimproved grasslands and arable land. Coastal acid grassland forms a minor component of this mosaic. Historically the species bred more widely in lowland England and declines may be due to changing agricultural practice, such as reduction of winter stubble, and habitat loss.

- **Short-eared Owl** Amber List

  In lowland England this species is virtually restricted as a breeding bird to eastern counties. It sporadically bred in Breckland in the late 19th and early 20th centuries. It currently breeds in small numbers in upland plantations and on wet grassland and feeds and winters over dry grassland, where it favours long grass, in Breckland, the Suffolk Sandlings and elsewhere. Winter numbers are supplemented by continental birds. The relative importance of dry grassland to the size of the British population is not known.

- **Rough-legged Buzzard** Green List

  A wintering migrant only, the short dry grasslands in the Breckland were historically important wintering areas. The wintering populations have declined and now occur mainly in eastern coastal areas.

- **Wheatear** Green List

  The Wheatear was previously widespread in rabbit grazed dry grassland in the lowlands, nesting in rabbit burrows adjacent to insect-rich, bare patches or short swards. It is now an irregular breeder in the lowlands away from the coast, except for rapidly declining populations in Breckland and the New Forest, where it is associated with acid grassland. It has died out as a breeder in the Malvern Hills (Gibbons *et al*, 1993). It still nests in acid grassland on coastal shingle in the Dungeness area (James, 1996).

Species for which lowland dry grassland contributes to the maintenance of the size or range of the British breeding bird population or wintering numbers.

- **Hen Harrier** Red List

  The Hen Harrier originally bred in diverse habitats including lowland dry grasslands, but breeding is now restricted to the uplands. Continental birds still winter in grass heath and heathland in southern and eastern England. Occasional summer records in these areas may imply that lowland breeding sites could possibly be re-established if extensive dry grassland and heath were re-created and colonists were free from human persecution.

- **Merlin** Red List

  A declining species that probably historically bred on extensive lowland grasslands but it now only breeds in the uplands. Significant numbers still winter on lowland dry grasslands and heathlands, with concentrations in Breckland and the New Forest.

- **Nightjar** Red List

  The Nightjar has suffered a severe historical population decline. Currently, birds are mostly found breeding among Bracken and Heather on heathland and in recently felled and re-stocked conifer plantations. These plantations mimic its traditional semi-natural habitats. In the past it was widely found in a range of habitats including dry grassland and working coppice woodlands. In the early 20th century, when it was abundant in Breckland and the Sandlings, it often nested in open, stony ground away from any cover such as Bracken and Gorse. A national survey in 1992 found that numbers of Nightjars breeding in Britain has increased to an estimated 3,400 pairs from half that number in 1981. This increase seems to have reversed a long-term decline (Cresswell 1996). Significant numbers still breed in the heath and acid grassland of the Sandlings, while populations in Breckland declined after myxamotosis. The largest populations here are now found in re-stocked conifer plantations. However the bird feeds over acid grassland and heath, as well as other invertebrate-rich habitats. The large New Forest population nests purely within heathland (Clark & Eyre, 1993).

- **Skylark** Red List

The skylark population has been suffering a very severe population decline in recent years. Whilst lowland farmland provides the main habitats, the Skylark does breed on dry grassland, including acid grassland. Re-creation of large areas of dry grassland could significantly increase local populations.

- **Peregrine** Amber List

Historically, wintering populations used dry grassland and heathland in Breckland. There are now only occasional records of wintering birds in southern England. Coastal grassland, of which acid grassland forms a minor component, contributes to the habitat of prey species of breeding Peregrine in the south-west.

- **Lapwing** Amber List

Lapwing breed on acid grassland as well as a variety of other habitats that have short vegetation or bare ground for feeding. Large numbers used to breed in Breckland but now the bird is rarely found breeding on dry grassland except in the New Forest, where a population of between 250-450 pairs nests in heathland, especially on grasslands created by war-time disturbance (Clark & Eye, 1993). Most inland lapwings now breed in the lowlands on arable land but productivity is much lower in this habitat and the population has been steadily declining.

- **Curlew** Amber List

This species is more typical of upland habitats but has expanded its range into lowland areas, particularly wet heath, mire and wet grassland. It has also colonised the Breckland grass heaths as lack of grazing has led to the growth of taller grass swards, which the bird favours for nesting. However, overall in Europe, populations appear to be declining.

- **Green Woodpecker** Amber List

The Green Woodpecker is a specialist ant-feeder. It has high population concentrations in acid grassland areas such as the New Forest and Breckland. It nests in trees but feeds largely on the ground. It prefers short, grazed, turf which supports high biomass and varied species of ants. Populations have declined in recent years, probably due to the loss of unimproved permanent pasture.

- **Hobby** Green List

Population trends are generally stable and perhaps increasing in places. It is a summer visitor and significant populations breed in heathland areas, particularly in the New Forest. Dry heathland and acid grassland are less preferred hunting territory compared to wet heath, mire, river valleys and other wetlands. However if the latter are not available, they can be important, for example, in Breckland birds breeding in plantations hunt over dry grassland.

- **Meadow Pipit** Green List

There have been no marked changes in populations of this species. It breeds in a variety of habitats including acid grassland, where this is not heavily grazed. Most birds breeds in the uplands but Breckland has high concentrations.

- **Whinchat** Green List

  This species was formerly widespread in the lowlands in fairly structured rough grazing, including dry acid grassland with gorse and bracken and mixture of these habitats with heath. This species has declined drastically in these habitats in recent decades, but still breeds locally in areas such as Breckland, the Hampshire/Surrey heaths and the New Forest (Clark & Eyre, 1993).

Other dry grassland species

- **Grey Partridge** Red List

  This species pricipally breeds on lowland farmland and it is still undergoing a severe, long-term population decline. Heath and acid grassland are secondary habitats and have lower breeding densities than the best farmland habitats.

- **Montagu's Harrier** Amber List

  Probably always a rare bird, this declining species historically bred on calcareous and acid grassland and heath. Since the late 1960s these habitats ceased to be used and most now breed in arable crops. However, recently Montagu's Harrier has resumed breeding on heathland in the New Forest and breeds sporadically on other semi-natural grassland sites.

- **Ringed Plover** Amber List

  The species once bred abundantly on rabbit warrens, fallow fields and grass heath in Breckland. The species was finally lost from grass heaths following the decline in rabbit numbers due to myxamotosis but still breeds very locally on arable fields in Breckland . The only inland breeding population surviving on dry grassland is that on the extensive acid grasslands created by war-time disturbance in the New Forest (Clark & Eye, 1993).

- **Stock Dove** Amber List

  This species has undergone some declines in Europe, though in Britain, populations have partially recovered following sharp declines in the 1950s and 1960s, attributed to the direct effects of organochlorine seed dressings. It was probably a woodland edge species originally but now is a farmland bird which makes minor use of dry grassland. Historically, large numbers bred in rabbit holes in heavily grazed warrens in Breckland and Lincolnshire. They probably benefited here from intensive control of rabbit predators.

- **Stonechat** Amber List

  This species is not mentioned by Dolman (1992a) but it certainly uses Gorse in acid grassland in the New Forest as well as Gorse in heath. It was once regarded as one of the most typical Breckland birds but breeding has been sporadic since the severe winters of the 1940's (Dolman, 1994).

- **Ring Ouzel** Amber List

  Ring Ouzel is restricted to the uplands as a breeding bird but acid grassland in Breckland forms part of spring and autumn passage habitats. The reasons for its recent population decline are unclear.

Species lost from lowland dry grassland

- **Wryneck** Red List

  Now extinct as a breeding species in England, this species primarily feeds on ants, located on warm bare ground or short grasslands. It formerly used acid grassland in Breckland. The loss of short grassland may have been a significant factor in its extinction as a breeding bird.

- **Red-backed Shrike** Red List

  Before its extinction in England, this species bred in habitat mosaics which included acid grassland and scrub. The reasons for its extinction are not clear. Factors that may be responsible include climate change, factors operating outside Britain, and the reduced availability of large invertebrates, as a result of change in agricultural practices.

- **Chough** Amber List

  This species is extinct in England and successful re-establishment, for instance in the south-west, will critically depend on availability of suitable coastal dry grassland and maritime heath habitats and productive donor populations within a suitable colonization distance.

- **Great Bustard** Extinct

  The species formerly bred on extensive dry grasslands and in open country with a mix of grassland and arable, including Breckland and Newmarket and Royston Heaths. Its requirement for unrestricted views of a kilometre or more suggests that habitat fragmentation, through, for example, shelter belt planting, was a strong factor responsible for its early extinction. Habitat loss and hunting pressure also contributed to its extinction.

6.1.3 Management requirements

The management requirements of dry grassland birds can be summarised under two broad headings that describe favoured vegetation structure.

Species that depend on or use closely grazed swards

Breeding Woodlark
Breeding Ringed Plover
Breeding Wheatear
Feeding Montagu's Harrier
Breeding Nightjar
Breeding Stone Curlew
Breeding Lapwing

Species that depend on or use lightly grazed or ungrazed swards

Breeding Skylark
Breeding Meadow Pipit
Feeding Short-eared Owl
Breeding Curlew
Breeding Whinchat
Wintering Hen Harrier

Management to provide a range of vegetation structure across the dry grassland habitat is therefore critical to conserve the full suite of birds which depend on it. The scale of the mosaic of varied structure will relate to the species under consideration. For instance Woodlark requires a small-scale mosaic within its breeding territory, with open areas with little vegetation cover for foraging, as well as longer vegetation for nesting. In contrast, Stone Curlew require landscape scale mosaics of suitable habitat to satisfy their nesting and foraging requirements.

Freedom from disturbance is another important factor in conservation management for some species, such as Stone Curlew. In addition, other habitats in a dry grassland landscape may be required, in particular arable land managed in a low intensity way, particularly with spring sown cereals and winter stubble.

Restoration of both low intensity arable regimes and re-creation of dry grassland in a mixed farming landscape are likely to be important if viable populations of dry grassland birds are to be conserved in the long term. The role of restoration of acid grassland in heathland landscapes thus deserves attention.

6.1.4 Key areas for dry grassland birds in England

Dolman (1992a) identified several key areas for priority action to conserve dry grassland birds. Key areas with existing acid grassland are Breckland, the Suffolk Sandlings, coastal grassland in south-west England, north Norfolk and the Lincolnshire Coversand heathlands. Dolman did not recognise the importance of acid grassland in the New Forest and other heathland areas. Areas likely to have potential or existing interest are the New Forest, the west Wealden heaths, the Thames Basin heaths and the Dorset heaths.

Several areas that include acid grassland as a major or minor component have been designated as Special Protection Areas under the EC Directive on the Conservation of Wild Birds or are proposed as SPAs. These areas are:

SPA: The New Forest; Minsmere-Walberswick

Proposed SPA: Breckland Heaths; Wealden Heaths; Dorset Heathlands

6.2 Reptiles and amphibians

All native British reptiles and amphibians can be found in habitats which include acid grassland. The following section summarizes the role of acid grassland in the requirements of each species. Further information can be found in the references given below.

6.2.1 Widespread species

The widespread species considered here are:

Adder
Grass Snake
Common Lizard
Slow-worm

Common Frog
Common Toad
Smooth Newt
Great Crested Newt
Palmate Newt

These species use acid grassland where it is adjacent to habitats that have a greater degree of structure , or form part of a mosaic of habitats that have this structure. It is the physical structure of the vegetation, rather than plant species composition, that generally determines whether these animals will be present. Reptiles need warm, open, or short areas of vegetation in close juxtaposition to areas that provide cover and shade so the animals can avoid extremes of temperature. Short acid grasslands close to taller vegetation such as heath are used for thermo-regulation. Where heavy grazing destroys this mosaic of structure, the habitat becomes unsuitable for the majority of reptile and amphibian species.

Adders and Grass Snakes are mobile species whose ranges may incorporate different habitats throughout the year. As a general rule these snakes occupy drier areas over the winter and early and late in the activity season, while occupying wetter habitats during the summer. Dry acid grassland can form part of these ranges. Physical structure is important and the effects of loss of structure through grazing, and to a lesser degree the disturbance that results from grazing, can make the habitat less suitable. Intensive grazing can cause the local loss of snake populations. Cover is also important for the prey species; for Adders these are usually lizards or small mammals while Grass Snakes tend to favour amphibian prey.

Common (viviparous) Lizards are ubiquitous, though again their distribution will be affected by the need for a varied vegetation structure. Slow-worms are a widespread species, and often over-looked. They will use acid grassland that offers sufficient cover or vegetation depth in which they can burrow and that provides a habitat sufficient to sustain their invertebrate prey (notably slugs and snails).

Amphibians require suitable land and water habitats. Acid grassland is a suitable habitat for all British native species, though generally only where it provides a good physical structure that offers cover and higher humidity levels. It also needs to be in reasonably close proximity to breeding ponds. Frogs and toads are particularly dependent on cover; they tend to sit and wait to capture invertebrate prey and therefore require safe, humid areas in which to live. All three native newt species are found in acid grasslands, though generally it is the Palmate Newt that is associated with the more acidic soils. Smooth Newts and Great Crested Newts are more often found in more nutrient-rich ponds than the ponds usually associated with acid grasslands. Again there is a need for sufficient vegetation structure, or alternatives, such as stone slabs, to provide cover and invertebrate food.

For further information see Corbett (1989), Beebee (1996), Madsen (1984), Prestt (1971), Smith (1990), and Stafford (1987, 1989).

6.2.2 Rare species

Three rare species are found in habitats that include acid grassland. All three species are specially protected under Schedule 5 of the Wildlife and Countryside Act 1981. A useful reference covering these species is Nature Conservancy Council (1983).

Smooth Snake

Smooth Snakes are restricted to the southern heathland areas of England, presumably limited by the need for a warm climate and microclimate. While the species is most frequently associated with mature dry heathland, Smooth Snakes are found in the full range of associated and adjacent habitats, including bogs and acid grassland. Areas with a very varied structure and ground cover (eg. with mosses, lichens and Bristle Bent Grass *Agrostis curtisii*) in which the snake can bury itself are ideal; these conditions are usually found in the drier areas of Heather-dominated heathland. However, snakes will make use of grassland patches and even make limited use of areas with very short, parched acid grasslands (U1); but probably only for transitory periods. The coarser Agrostis curtisii grasslands (U3) are important when they form part of a heathland mosaic. They are frequently used for basking out of sight, and the snake can lie deep in the grass sward without being obvious to predators. For further information see Gent (1988) and Goddard (1981).

Sand Lizard

Like the Smooth Snake the Sand Lizard is associated with mature heathlands in southern England, although this species is also found on dunes in southern England, north-west England and north Wales. The species needs warm habitats which have a mosaic of warm, open areas or short vegetation in which the animal can bask, in close association with dense vegetation that provides cover from extremes of weather and predators. Sand Lizards also need areas of open bare sand, or similar soils, in which they can dig burrows to lay their eggs. Adult animals also tend to live in burrows excavated in soft soil. Where acid grassland is located in close proximity to some form of cover, then it can form part of the core habitat of Sand Lizards. In the absence of any heather cover, Agrostis curtisii grassland (U3), with Gorse bushes providing the cover, has been recorded as supporting Sand Lizards in Dorset (Corbett, 1994). For further information see Corbett and Tamarind (1979), House and Spellerberg (1983) and Nicholson (1980).

Natterjack Toad

Among the native amphibians and reptiles found in Britain the Natterjack Toad has probably the closest relationship with acid grassland. The species was once widespread in heathland habitats in southern England and East Anglia. The last surviving native heathland site for this species in east Hampshire includes a mosaic of dry heath, species-rich parched acid grasslands, sand sedge communities and ephemeral ponds (H1, H2, U1a, U1b, U1c, SD10, SD11 & M30) and has a nationally important acid grassland flora. The Natterjack Toad is now generally confined to a range of coastal sites, mostly sand dunes or grazing marshes in north-west England and south-west Scotland and eastern England.

Natterjacks like open, early successional habitats or places where the vegetation is kept open, for example by grazing. These open habitats, which include short acid grasslands, are preferred for two reasons. Firstly they provide suitable habitats for foraging because the natterjack actively hunts its invertebrate prey rather than ambushing it from cover. Secondly such habitats are inhospitable to the common amphibians which will out-compete the natterjack in habitats where they are able to become established. Natterjacks are burrowers, and can thus avoid extremes of day-time temperatures and desiccation. Common Frogs and Common Toads are unable to do this and, in the absence of vegetation cover, will not survive. However, it appears that a major reason for the common amphibians ousting the Natterjack is the fact that they breed earlier. The tadpoles from these earlier spawnings grow and inhibit the growth of later hatchlings, apparently through a mechanism involving a single-celled alga which passes through the gut of the tadpoles (Griffiths et al 1991).

Natterjacks require breeding pools that are warm and are circum-neutral in pH. Acidity below pH 5.0 tends to inhibit growth and development. The ideal pond is shallow, with few if any plants growing in it. It will also dry up in late summer and refill the following year. These characters make the pond less suitable for invertebrate predators which can eat large numbers of Natterjack tadpoles. Often the ponds on podzolic soils of heath and acid grassland are too acidic to support Natterjack breeding; however there are areas where change in soil type, for instance soils associated with U1 (Festuca ovina-Agrostis capillaris-Rumex acetosella) grassland, or areas with enriched or disturbed soils, where ponds with a suitably high pH can be found that allow breeding.

For futher information see Beebee and Denton (1996) and Denton *et al* (1995).

6.3 Invertebrates

The ecology of invertebrate assemblages in acid grasslands has not been extensively studied in Britain. There have been a few broad-scale classifications of particular groups in grasslands, which have included dry, sandy habitats. These may have been akin to lowland acid grassland in character although no plant species lists are given (Eyre and Luff 1990, Luff et al 1992, Rushton et al 1987). In what appears to be one of the few studies of its kind, Cherrill et al (1997) compared classifications based on plant bugs, leaf hoppers, ground beetles, spiders and plants sampled from upland moorland. The closest agreement was found between the classifications based on plants and the pooled invertebrate data. The assemblages based on all invertebrate species showed a closer relationship with the vegetation than might be expected from analyses of any one invertebrate group. It would be useful to examine lowland grassland faunas and plant communities in a similar way.

Several invertebrate groups have been well studied at Silwood Park, which contains areas of acid grassland. The Park was once part of Windsor Great Park and the acid grassland areas appear to be somewhat similar to U4 (Festuca ovina- Agrostis capillaris-Galium saxatile grassland) among the NVC acid grassland types, apart from the anthills which support species such as *Ornithopus perpusillus* and *Aira praecox*, which are more characteristic of U1 (Festuca ovina-Agrostis capillaris-Rumex acetosella grassland) (Waloff and Blackith 1962, Waloff and Solomon 1973, Waloff and Hassell 1982).

The spider fauna of the acid grassland at Silwood was found to be similar in numbers of species to limestone grassland at Wytham Wood near Oxford, with 60% of the species being common to both grassland types (Waloff and Hassell 1982). Vegetation structure rather than composition is of greater importance for many invertebrate groups such as spiders, as perhaps is the case for the assemblage of rare spiders in U2 (Deschampsia flexuosa grassland) in the Sherwood Natural Area (NA 32), Nottinghamshire (see **Volume II** county account). However Kirby (1992) points out that many of the invertebrates which occur in acid grassland are specialist species that are not found in calcareous or neutral grassland. It is also possible that acid grassland species have been lumped in a more general "heathland" category in descriptions of habitat preferences of particular invertebrates. Many plant-feeding invertebrates require the presence of particular plant species. Examples among scarce species of acid grasslands are the nationally scarce beetle, *Ceutorhynchus pumilio*, found on *Teesdalia nudicaulis*, and the nationally rare moth *Neofriseria singula* on *Rumex acetosella* (Dr Martin Drake, EN, pers comm).

Acid grasslands are often associated with loose, sandy soils which are important for a considerable number of burrowing invertebrates and their predators, parasites and scavengers. The majority of solitary bees and wasps nest in the ground and prefer dry, light and often sandy soils. South-facing banks and unstable slopes are favoured, especially when only sparsely vegetated or where the sward is short (Falk 1991). The importance of dry bare ground to such invertebrates means that parched acid grasslands (U1), where bare ground can comprise 30% or more of the area occupied by the community (Rodwell 1992), are usually likely to be of greater interest than U2, U3 (*Agrostis curtisii* grassland) or U4, where swards may often be closed, taller and occur on moister soils. Invertebrate diversity is increased if flower-rich habitats occur in the vicinity of patches of open ground. Many acid grasslands have a rather low abundance of flowers and provide a lower supply of pollen and nectar than some other semi-natural grasslands. An exception is the parched acid grassland type U1f (Hypochaeris radicata sub-community), which can be rich in mid- to late-summer flowers of the Asteraceae, including *Hypochaeris radicata* and *Leontodon saxatilis*.

Acid grasslands provide habitats for a number of rare and scarce invertebrates. The last Large Blue (*Maculinea arion*) butterfly colony that existed in Britain before the species became extinct in the 1970s was located on an acid grassland (Elmes and Wardlaw 1982a). Vegetation samples show *Agrostis curtisii* to be the most abundant species, but growing with quite a wide range of other calcifuges, including the nationally scarce *Viola lactea*, as well as more catholic herbs such as *Pilosella officinarum* and, of course, *Thymus polytrichus*, which is the food plant of the butterfly (Elmes and Wardlaw 1982b). The ant species on which the butterfly depends for rearing its larvae is *Myrmica sabuleti*, which also occurs elsewhere in association with *Agrostis curtisii* grassland (Brian et al 1976). The Large Blue was re-introduced into its last native site in 1985 (Thomas 1989).

Other rare and scarce invertebrates occur in acid grassland and heathland mosaics as shown by an analysis of Natural Areas being prepared by Dr Martin Drake. For example in Breckland (NA 46), the nationally scarce Lunar yellow underwing moth (*Noctua orbona*) and the nationally rare ground beetle *Harpalus froelichi* occur on the grass heath areas. On the dry heathland of the Wealden Greensand (NA 70), the very rare Field Cricket (*Gryllus campestris*) is found. This species favours steep south facing banks or areas of sparsely vegetated sandy ground (Edwards et al 1996). The Heath Grasshopper (*Chorthippus vagans*), is another nationally rare representative of the Orthoptera that occurs on the Wealden heaths. The acid grasslands of the New Forest (NA 77) also support this species, as well as the nationally scarce Hornet Robberfly (*Asilus crabroniformis*). The latter two species also occur on the acid grassland and chalk heath of the Isles of Portland and Purbeck (NA 82) and in several other Natural Areas.

Bracken habitats associated with acid grasslands (see section 2.3.10 above) can be important for fritillary butterflies, in particular the High Brown Fritillary *Argynnis addipe*, which breeds on *Viola* spp (Warren and Oates 1995). The High Brown has declined severely in the last 40 years and is now one of Britain's most endangered butterflies (Warren and Oates 1995).

Where management of acid grassland is intended to maximize diversity of invertebrate species, the aim should be to produce a dynamic successional mosaic with structural variety ranging from bare ground to mature tussocky swards and sparse scrub. Grazing is generally the preferred type of management as it can prevent the build up of litter and it results in additional dung and carrion habitats. In general the decomposer faunas associated with dung and carrion are much more important on dry, friable soils than on heavy water-logged substrates (Dr David Sheppard, EN, pers comm). Mowing is likely to be much less favourable for maintaing a rich invertebrate fauna as it usually results in a sward which has a more uniform structure than a grazed sward and which lacks significant areas of bare ground. Disturbance and grazing by rabbits can produce good invertebrate habitats.

7. Management of lowland acid grassland

7.1 Introduction

A good summary of grassland management for nature conservation, including acid grassland, is given in Crofts & Jefferson (1994) and readers are referred to this document for technical detail, including animal welfare issues. In the following chapter, an outline of the management requirements of acid grasslands is given together with an assessment of the current management condition of acid grassland in the lowlands. Grazing is the main management tool on acid grasslands in England. However, it should be noted that safeguarding acid grasslands from particular agricultural inputs is very important, ie organic and inorganic fertilisers and lime. These will raise the productivity and nutrient status of the soil and will damage or destroy acid grassland. In some cases, existing Environmental Land Management Schemes, particularly ESAs, which offer incentive payments for the conservation management of habitats, do not have prescriptions specifically aimed at acid grasslands. Their conservation requirements need to form part of scheme review and be included in information supplied to Project Officers.

7.2 The role of grazing

Lowland acid grassland has historically always been grazed. Cattle, sheep, ponies, rabbits and deer are all current grazers of acid grassland. In the east of England, rabbits and sheep, eg in Breckland (Lambley, 1994), have been especially typical but other mixtures occur elsewhere, as for example, the cattle and pony system of the New Forest (Tubbs, 1987 & 1991) and fallow deer in parkland. (Hatch Park, see **Appendix 1**).

Historically, acid grassland formed part of a series of grazed habitats, that formed extensive grazing systems. The acid grassland present was usually grazed very short as can be seen in the best remaining example of an extensive grazing ecosystem, the New Forest. (Tubbs 1991 and Sanderson 1995b). Here the grasslands are more productive for forage than other parts of the system, such as heaths or Bracken stands. As a consequence, the grasslands are heavily grazed in contrast to the less palatable vegetation elsewhere, which is allowed to grow taller.

In the past, the habitat was often regarded as grossly over-grazed by contemporary commentators. On sandy soils this level of grazing could even lead to mobile dune formation as in Breckland. Even in recent times the New Forest acid grasslands have often been described as over-grazed (Putman, 1986). However much of the diversity of acid grassland depends on heavy grazing (Winship 1993 and 1994, Byfield & Pearman 1995 and 1996 and Chatters 1996).

A requirement for areas of short vegetation, usually 2cm or less, and often patches of bare or near bare ground is a common feature of many declining rare and local species of lowland acid grassland. For example:

- The loss of nationally and locally scarce vascular plant species which are characteristic of short, acid grasslands in the Dorset Heaths is more than twice as high (88%) as the actual physical loss of heathland as demonstrated by Byfield & Pearman (1996).

- On a wider scale the decline of many of the characteristic flora and fauna of the Breckland is related to loss of short grassland. (Dolman 1994, Duffey 1994, Haggett 1994 & Lambley 1994a, 1994b and 1994c).

Some species have requirements for vegetation with a greater degree of structure as well as, or instead of, short grassland, but these requirements have usually been provided by less palatable species such as Heather, Bracken, Gorse, Birch and unpalatable herbs, rather than by taller grassland.

There appear to be few rare or local species which have benefited from the decreased levels of grazing that have produced taller grass swards. Those that have benefited seem to be recent opportunists for which there may be alternative, existing or potential, habitats. Examples are the Curlews of Breckland which have colonised the area as sward heights have increased, and which could find alternative habitats in restored valley fens or wet grasslands. Similarly, Skylarks are more productive in taller grasslands but survive in shorter acid grasslands and could perhaps benefit more from the provision of better habitat on more mesic grasslands rather than a greater area of under-grazed dry grassland (Dolman, 1992a). The short-sward specialists, however, often have fewer, poorer, alternatives, such as arable crops for Stone Curlew, where their productivity is lower than on short dry grassland.

In the past the effects of grazing in producing open swards was augmented by other forms of disturbance, many of which are no longer operational. This disturbance included mineral exploitation, military activities and temporary arable cropping. The latter was typical of Breckland and probably other areas of eastern England but its last large scale application was in the New Forest where significant areas of heath and acid grassland were cultivated during the 1940's and 1950's. They were then abandoned after being sown with pasture grasses. These have now reverted to acid grassland and herb-rich heath.

Consultations with local conservation officers across English counties (see **Volume II**), found a regional difference in the decline in grazing management. The abandonment and fragmentation of extensive pastoral ecosystems is greatest in the south and east. Grazing is more frequent in the west and into the upland fringe. Traditional grazing has been maintained on the common grazings of the New Forest which includes a large area of acid grassland. Small patches of good quality acid grassland have survived elsewhere where they have been located within more productive grazed grasslands. Fragments are also found in areas where the rabbit population has recovered, and in the open conditions produced by abandoned mineral workings.

In the last decade, however, grazing management has increased once more, due mainly to incentive schemes such as Countryside Stewardship, Environmentally Sensitive Areas, Wildlife Enhancement Schemes and various heathland initiatives. In areas such as the Breckland ESA, significant areas of the surviving grass heath is now being grazed, and sites in the Coversands WES scheme have dramatically improved in habitat quality (see **Appendix 1**).

7.3 Types of grazing animals

As long as suitable combinations of hardy animals are used, there is no one type of grazing regime which can be particularly recommended as being correct. Local tradition and history are probably as important as biodiversity considerations. A mix of grazers is often more beneficial than a single type. Traditional breeds of cattle and sheep are usually more suitable than modern, more productive, types. The following characteristics of the different grazers should also be considered:

- **Sheep**

  These are traditional in many areas in the east but were hardly ever used in parts of the south and were never turned out in significant numbers in the New Forest in the last five hundred years. Soft mouthed breeds are especially poor at eating coarse grasses such as *Molinia* and *Deschampsia flexuosa* and their light weight means that they are poor at creating open ground. Rabbit grazing, where it occurs, can help to counteract this problem. Sheep are also more likely to damage Heather stands by over-grazing than ponies or cattle, and are not very suitable for heathland sites with mires.

- **Cattle**

  Cattle are significant grazers of acid grassland in the New Forest but animals grazing here need special skills to be able to cope with grazing very short swards. According to New Forest commoners the cattle achieve this by using their gums like teeth but outside stock can find this difficult if they have been brought up on longer swards. Cattle are very good at grazing mixed sites with wet areas and coarse grasses, and are less likely to damage Heather than sheep. Most beef breeds or crosses can be used.

- **Ponies**

  Hardy native breeds are very versatile and are especially efficient at grazing extensive heathland sites and eat little Heather. They are the most important grazing animals in the New Forest. Ponies can graze acid grassland swards very short and produce swards with a low grass cover but with a high diversity and cover of lower plants and specialist vascular plants. Ponies often need to be combined with at least some cattle which graze the coarse grassland of pony dunging areas, but this problem is much less significant in extensive grazings than within small fields.

- **Rabbits**

  These were farmed in warrens, especially in sandy grass heaths in the east until the middle of this century. Before myxomatosis, rabbits were the major grazer that maintained relic acid grassland in heathlands and grass heaths. Locally they are still important, and maintain many small areas in good condition as well as larger areas such as Weeting Heath in Breckland (Dolman 1992b and Grice 1994). They create short, very high quality, swards and patches of bare ground. However, their grazing tends to be patchy, and they have difficulty reclaiming areas allowed to go rank. They avoid several species such as Roseby Willowherb and really need to be combined with at least some stock grazing. Combination with occasional mowing can be very effective but rabbit populations can crash. It is therefore advisable to have the ability to graze with livestock if required.

- **Deer**

  Fallow deer graze some acid grasslands in parks. Observation suggests they are rather inefficient on their own and can allow a thatch of fescues and bents to build up (Sanderson, 1994b). They are possibly best combined with cattle or ponies as grazing by sheep can have similar effects as deer.

7.4 Stock management and grazing levels

In managing stock, the experience of the New Forest indicates that the most effective and efficient method is to make the grazing units as extensive as possible and allow the animals to behave as naturally as possible (Putman 1986, Gill 1987 and 1994 Tubbs, 1987 and 1991, and Sanderson 1995b). The natural development of a varied vegetation structure is less likely to occur in small enclosures.

It is also essential, for reasons of animal welfare, to allow the animals to use their instincts to the full, to cope with low quality grazing. Animals in extensive grazings are constantly shifting for one habitat to another and this sequential exploitation of habitats is the key to their survival on poor grazings. Extensive grazing areas also allow the formation of coherent social herds for instance, the home range of ponies on the New Forest can be between 80ha to 1000ha (Tubbs, 1987). Ideally, management units would be at least hundreds of hectares in size. However much smaller areas can be satisfactorily managed.

Obtaining suitable stock is a major constraint in some parts of the county, especially the east, where much of the stock rearing that survives uses productive modern breeds which are not suitable for rough grazing. Solutions to this problem are not yet clear, but in the east of the country conservation bodies are acquiring their own livestock. In the long term, restoration of entire pastoral systems is likely to be a more satisfactory answer than attempts to graze heathlands and grass heaths in isolation, especially as some additional, more productive land is usually essential anyway.

Grazing levels are difficult to summarise in a national review, but grazing pressures are likely to be in the range of one pony, one store cattle beast or two sheep per 1-4ha per year, depending on the mix of grassland with lower productivity vegetation and the nature conservation objectives of the management. Grazing levels will need to be set by reference to the actual effect on the vegetation. General guide lines for acid grassland are:

- The dry U1 Festuca ovina - Agrostis capillaris - Rumex acetosella grasslands should be generally grazed to less than 2cm in height, with at least some very short areas and bare ground.

- Wavy hairgrass, *Deschampsia flexuosa,* swards (U2) generally will be changed by grazing and approach U1 and U4 in composition, as *Deschampsia* is very sensitive to grazing by all but sheep and deer. Sometimes retaining some structure may be desirable for invertebrates such as spiders.

- Dense Bristle Bent *Agrostis curtisii,* swards (U3) can be opened up by grazing to allow a greater diversity of species to thrive but taller swards may need to be retained for example, for Smooth Snake (see Chapter 6).

- In the uplands, U4 (Festuca ovina - Agrostis capillaris - Galium saxatile) grassland is usually heavily grazed (Rodwell 1992). The impact of different levels of grazing on species diversity of this community are not clear but bryophytes are favoured by heavy grazing. Conversely, it is likely that more herb-rich examples of U4 (eg U4c, containing species such as *Succisa pratensis*) may be adversely affected as is the case for herb-rich stands of MG5 (Gibson 1997). Recommended sward heights for these grasslands are at least 5 cms through most of the grazing period and not less than 2-5 cm at the end of the grazing period (English Nature and British Horse Society 1997). There is a growing realisation that the fungi flora of U4 may be nationally or even internationally important (see Chapter 5) but as yet there is no information on the impact of grazing management on this flora.

- Sufficient grazing should be carried out to control the spread of invasive plants, such as Bracken and scrub and manage existing scrub (see below).

The interpretation of these guidelines must be flexible and adjusted to local conditions and special species interests.

7.5 Other management

7.5.1 Mowing

Mowing can act as a partial substitute for grazing where this is not feasible. The constant mowing found on golf courses and air fields, as at Greenham Common (Porley 1993 and EPR 1995), has maintained the flora of species-rich acid grassland. However, this management is not ideal for the fauna (Kirby 1992), and a better method is to use occasional mowing to encourage increased rabbit grazing. Mowing may be an effective technique for managing small, isolated, sites. cuttings should always be removed from the grassland to prevent nutrient enrichment.

7.5.2 Bracken

In dealing with bracken, it is important to evaluate its conservation interest or potential interest in providing structural diversity before attempting to eradicate it, (Pakeman and Marrs 1992). Bracken growing on podzolic soils, which could support heath, can generally be treated with eradication as the aim, but Bracken on brown earths is more problematic. Where stands with little litter accumulation have plant species such as *Hyacinthoides non-scripta*, *Anemone nemorosa* or *Convallaria majalis,* which are generally absent from acid grasslands, or have species which are suitable for invertebrates, especially violets *(Viola* spp.) then eradication is not advisable. Such areas can harbour declining species such as the High Brown Fritillary, *Argynnis addipe,* (Warren and Oates, 1995) or rare plants such as *Gladiolus illyricus* (Pakeman and Marrs 1992). If this is the case, an alternative is rotational late summer harvesting of Bracken litter, possibly for composting, combined with cattle and/or pony grazing. This prevents the smothering build up of bracken litter and hence plant species diversity is maintained, but allows moderate amounts of litter accumulation which is important for over wintering invertebrates or basking butterfly larvae (Warren and Oates 1995). Grazing alone may be able to maintain suitable conditions, for instance on the fringes of Dartmoor where several sizeable populations of High Brown Fritillary occur (Warren and Oates 1995).

7.5.3 Gorse and other scrub

Gorse is a important structural component of many acid grasslands and supports a rich invertebrate fauna. Other scrub species such as Broom and Hawthorn can occur locally and provide nectar sources. Gorse requires rotational management by cutting or burning in order to retain dense cover and shelter (Michael 1996). In ungrazed conditions this rotation may be as short as 10-12 years but in traditional grazed systems, such as the New Forest, it is usually much longer due to winter browsing of young Gorse, especially by ponies. Other species can also be managed by rotational cutting. Scrub may need to be controlled where it is invading grassland, for details on techniques see Crofts and Jefferson (1994) (Michael,1996).

7.5.4 Soil disturbance

Bare ground is a very important feature of acid grassland. In the past it was often produced as a consequence of exploitation, for example intensive grazing or mineral exploitation , but in modern conditions, where development is controlled and grazing is often lacking, special provision may be needed to maintain the bare ground component of sites. Past work in Weeting Heath in Breckland (Dolman 1992b and Dolman & Sutherland 1992) indicates that shallow soil disturbance by rotovation is highly beneficial to the specialist flora and fauna of the grass heaths, but that deeper disturbance by ploughing is much less beneficial.

Much recent work on heathlands has been carried out on the question of whether to strip or bury organic layers that have built up on ungrazed heathlands. The aim of this practice is usually to reduce the dominance of coarse grasses, and to encourage the growth of Heather (Bacon, 1996). In grazed situations, these coarse grasses are suppressed, and humus build-up is slow.

Methods for removing the organic layer are expensive and can leave unsightly piles of waste. Burying the organic matter by use of a turf burying machine may be more acceptable but runs the risk of burying the seed bank and invertebrates present in the litter layer. There is also the possibility of damaging archeological remains. There is clearly a need for long term trials of different methods and their impacts. Without re-introduction of adequate grazing there is a danger that soil manipulation may be only a palliative measure, but could be useful as a short-term solution.

7.6 Habitat diversity and scale of management

In the past there has been a widespread failure by English conservationists to appreciate the crucial role of acid grasslands, and habitat diversity in general, within lowland heathland landscapes. This has led to what Clive Chatters of the Hampshire Wildlife Trust has aptly termed the 'grouse moor syndrome'. ie the concentration on the conservation of Heather stands whilst a massive decline has occurred in heathland species that specialise in associated habitats. The latter have suffered a much more serious decline than the heath specialists (Tubbs 1991, Byfield and Pearman 1995 and 1996 and Sanderson 1995b).

While small areas of parched acid grassland rich in annual plant species can be conserved with rabbit or livestock grazing, perhaps combined with mowing or rotovating, the conservation of other acid grassland species such as birds requires conservation management of much larger areas. The restoration of functioning heathland and grassland systems would require the recreation of the entire pastoral infrastructure including associated low-intensity farmland as well as hundreds of hectares of rough grazing.

Dolman (1992a) suggests the restoration of entire landscapes including low intensity farms, for the recovery of populations of dry grassland birds while Tubbs (1996) points out the vital importance of extensive pastoralism, including associated arable land, in conserving much of Europe's biodiversity, and the threats this is under from abandonment and intensification. The large-scale restoration of functioning cultural landscapes is more likely to provide a sustainable basis for biodiversity conservation than conserving existing habitats alone.

7.7 Restoring and re-creating acid grassland

Restoring diverse landscapes that include acid grassland will require large-scale habitat restoration and re-creation. Experiments to this end are already underway in two distinct situations; first restoring open heath or grass heath by clearing woody species, and second by re-creating these habitats from abandoned arable land. Information on areas with suitable soils and past concentrations of acid grassland species, as described in previous chapters, can assist with the targeting of these re-creation and restoration efforts.

7.7.1 Restoration

The clearance of planted trees or colonised trees and scrub is technically much the same, but can have different land use and political implications. Where the soils under the trees and shrubs have been little altered, the regenerating vegetation is usually close to that of the original heath or grass heath vegetation. An example of restoration is the clearance on the Dorset Heaths carried out by Forest Enterprise, the RSPB and others. (FC 1991).

7.7.2 Re-creation

Re-creation is most likely to succeed where soils are very sandy and free-draining. In these situations the impact of high inputs of artificial fertilisers, made during the period the land was in arable production, is less likely to persist in the long-term. Historical examples of arable reversion include parts of Breckland (Lambley 1994c) and the areas of heathland cultivated during and after the Second World War in the New Forest (Tubbs 1987). The main features of these examples is that they are now largely acid grasslands rather than heath, they can be exceptionally rich in uncommon and declining species, and that they bear little relationship to the vegetation of podzolic soils which have a longer history of lack of disturbance. In the New Forest, even where Heather has recolonised, a remarkable herb-rich community, undescribed by the NVC, has developed. The herb-poor heaths that are regarded as characteristic of lowland dry heaths seem to be essentially communities of highly leached podzols which can take hundreds of years to develop. In the New Forest, most low productivity heath has developed on land abandoned in the Bronze Age, while fields abandoned in medieval times still differ in vegetation from older heath, especially in the amounts of Gorse (Tubbs, 1987).

Recent attempts to create Heather-dominated heath have also created acid grassland of interest, more or less by default. An interesting example was seen by the author at Manton Warren in North Lincolnshire in 1997. Here about 6ha of arable land on very sandy soils was put into Countryside Stewardship in 1992. By 1997 it had been colonised by 11 acid grassland indicators (Table 8), including *Carex arenaria* and *Filago minor* and two nationally scarce species, *Hypochaeris glabra* and *Vulpia ciliaris ambigua.* The field was dominated by an early successional form of U1c, and the ungrazed vegetation in two small exclosures indicated that heavy rabbit grazing was important in suppressing coarse grasses and herbs in the rest of the field. Active blow outs and a sand dune had also developed. Interestingly, this striking site had been considered a failure as no Heather had colonised, whereas it actually had considerable nature conservation interest. A similar area of acid grassland developing on former arable is described in Breckland by Marrs (1985).

This evidence suggests that attempts to produce only heath from reverted arable land may be misguided. Abandoned arable land on poor soils will generally be more easily converted to species-rich acid grassland, including mosaics with grass and herb-rich heath. Interestingly, Dutch conservationists studying the New Forest 'brecks' have shared this conclusion and are allowing short dry grassland to develop on former arable land included within heathlands in the Netherlands, to which grazing has been restored, rather than attempt to restore heath (Prins 1992). These acid grasslands on reverted arable land can form part of a habitat mosaic with heath restored by clearance of woody species, as part of a restored, extensive, pastoral system.

8. Survey requirements and priorities

The following section relates to the requirements and priorities for assessing the location, extent and conservation interest of the acid grassland habitat and flora. There may need to be other work on fauna, particularly invertebrates.

8.1 Existing vegetation data

There are only a limited number of vegetation surveys of areas with rich and important examples of lowland acid grassland. Some detailed Phase 2 surveys have been carried out or have been commissioned by NCC and EN in key acid grassland areas, and these are listed below:

- Ferry *et al* (1990), Dungeness
- Wigginton (1990), Humberside Coversands
- Soden (1991), Sherwood Forest U2 grass heaths
- Porley (1992), selected acid grasslands of Dorset
- Porley (1993), Greenham Common
- Smith & James (1995) and Smith (1996), Suffolk Brecklands
- Steven (1995), Windsor Park.

Other Phase 2 surveys directed at neutral and calcicolous grasslands also recorded acid grasslands when they were found in association with these grassland types (see **Volume II**). The Biological Surveys of Common Land were also found to be useful, in spite of being basically Phase 1 surveys, as the NVC communities present are often mentioned (see **Volume II**).

There is also a considerable amount of survey work being carried out by NGOs, but most of these do not map or identify NVC communities, making it difficult to relate the results to any national context. Phase 1 surveys are especially problematic. The determination of acid grassland appears at times rather inconsistent and it is clear than the NVC is crucial to a proper understanding of the acid grassland resource of England. An example is given by the Biological Survey of Common Land of Hertfordshire (Francis *et al*, 1990); this identified 55ha of unimproved acid grassland which included wet acid grassland and 44ha of semi-improved acid grassland, most of which appeared to be permanent pasture (MG6b). Francis *et al* (1990) point out, however, that a 1988 Hertfordshire County Council Phase 1 survey recorded 480ha of acid grassland on the same commons.

As well as these vegetation data, much plant species data are held by the Biological Records Centre, local record centres and vice-county recorders. These data are most accessible when published in local floras. Some modern county floras proved to be invaluable sources of data, with the Shropshire (Sinker *et al* 1985) and Northamptonshire (Gent & Wilson, 1995) floras being especially informative.

8.2 Survey and monitoring requirements

There are two main requirements for data on acid grassland vegetation:

- Phase 2 surveys to provide better information on the types, extent and patterns of distribution of the NVC communities, especially the parched acid grassland community (U1), and its sub-communities.
- The floristic assessment of acid grassland sites, including rare and scarce species, possibly using the provisional indicator list (**Table 8**) proposed here as a measure of diversity.

In the past, the primary purpose of Phase 2 surveys has been to find new sites of SSSI quality. While many acid grassland sites of high value will already have been included within SSSIs as part of larger habitat mosaics, there are still important sites in heathland areas which have been excluded from nearby SSSIs because they lack Heather. Agriculture improvement and development have damaged or threatened such sites in Hampshire and Dorset in recent years (Colebourn 1994 and Sanderson & Stanbury 1996). In addition the value of the acid grassland component of existing SSSIs has often not been determined. Such information is needed to inform management decisions. Phase 2 surveys should thus have two main priorities:

- The surveying of known sites of importance including SSSIs, for acid grassland resource assessment and for monitoring and management baseline purposes, Smith & James (1995) and Smith (1996) are good examples of this type of data collection.
- Surveying heathland areas for habitats, including acid grassland, either fringing, or in the vicinity of heaths. Such sites may have been over-looked due to past prejudices against habitat not dominated by ericaceous shrubs.

NGOs should be encouraged to identify NVC communities during surveys, of their reserves and County Wildlife Sites. While the second requirement for floristic assessments can be met at least in part by Phase 2 survey, records could be augmented by existing site records held by vice-county recorders, local record centres etc. One-off visits during Phase 2 surveys rarely record all the species of interest present.

As far as possible surveying should be concentrated in May and early June when ephemeral species are identifiable. Some species such as the annual *Lotus* species appear later, and follow up surveys would be needed to fully establish the flora of an acid grassland site. Work on the important fungi floras of acid grassland also needs to be encouraged.

8.3 Development of the NVC

The NVC has been a great boon to understanding acid grasslands but there are a few points where further investigation is needed. The most important are:

- Full characterisation of Festuca-Agrostis-Rumex grassland, Hypochaeris sub-community (U1f). This is under-sampled in the NVC and stands that are referable to it, or are related to it, cover a wide range of complex variation.
- Should herb-rich transitions between MG5c and U4 resembling, but not identical to, CG/U4 transitions (U4c), of the White Peak be described as U4c? If not, how should they be treated?
- Sub-communities of U3 need to be defined.

- The characterisation of scree and cliff vegetation related to, but not contained within, U1 needs attention.

8.4 County and Natural Area survey priorities

The following assessment of survey priorities is based on information gained during the county by county review (see **Volume II**). In some areas, Phase 2 surveys are in a priority, while in others the review of existing data, floristic assessments, or sample Phase 2 surveys for monitoring purposes may be more important. The following assessment covers the priorities for lowland acid grasslands only (**Map 23**). Several other areas require further neutral grassland surveys and these should cover any acid grassland found in sites being surveyed for neutral grassland.

- *High Priority*

  Bedfordshire, Cambridge & Buckinghamshire: Bedfordshire Greensand Ridge (NA53). Phase 2 survey and floristic assessment.

  Cornwall & Devon: Cornish Killas and Granites (NA95), South Devon (NA91), West Penwith (NA96), The Lizard (NA97). Assessment of condition, extent and conservation needs of cliff-top, U1f, grassland.

  Dorset: Dorset Heaths (NA81) and Isles of Portland and Purbeck (NA82). Floristic assessment of acid grassland in south east Dorset, bringing together existing data. Possible follow-up Phase 2 surveys.

  Hampshire: The New Forest (NA77). Phase 2 surveys of selected areas of acid grassland for monitoring purposes.

  Hampshire, Surrey and West Sussex: Wealden Greensand (NA70). Phase 2 surveys where detailed information is lacking and overall floristic assessment.

  Herefordshire, Shropshire and Staffordshire: Midlands Plateau (NA43). Phase 2 survey and floristic assessment of acid grasslands in heathland areas in the south west of the Midlands Plateau, centred on Kidderminster.

  South of Former Humberside, Lincolnshire and Nottinghamshire: North Lincolnshire Coversands and Clay Vales (NA34), Trent Valley and Rises (NA33) and Lincolnshire and Rutland Limestone (NA38). Phase 2 survey and floristic assessment of unsurveyed acid grasslands and dunes on Coversand is a high priority. The floristic assessment of heaths surveyed outside the optimum season, and monitoring, particularly of incentive schemes, are moderate priorities.

  Norfolk: Breckland (NA46): Phase 2 surveys, including monitoring baselines, and floristic assessment.

  North East England: North Northumberland Coastal Plain (NA1) and Border Uplands (NA2). Phase 2 survey for monitoring purposes of selected Whin Sill sites.

  Suffolk: Suffolk Coast and Heaths (NA49). Phase 2 surveys and floristic assessment of the Sandlings acid grasslands.

- *Medium Priority:*

  Cornwall & Devon: Cornish Killas and Granites (NA95), Bodmin Moor (NA94), The Culm (NA93). Assessment of the role of lowland acid grassland, especially U3, in heathland ecology and biodiversity.

  Essex: London Basin (NA66). Phase 2 survey and floristic assessment of north-east Essex.

  Hampshire, Surrey and Berkshire: London Basin (NA66). Phase 2 surveys in heathland areas and Thames river terraces, where detailed information lacking, and overall floristic assessment.

  Isle of Wight (NA76): Floristic assessment of acid grassland and at least sample Phase 2 surveys.

  Kent: Wealden Greensand (NA70) and North Kent Plain (NA68). Floristic assessment of acid grasslands and sample Phase 2 surveys.

  Norfolk: North Norfolk (NA47) and The Broads (NA48). Phase 2 surveys, including monitoring baselines and floristic assessment.

  Nottinghamshire: Sherwood (NA32). Phase 2 survey and floristic assessment of any U1 acid grasslands in the Sherwood Forest area.

  Shropshire: Shropshire Hills (NA42) and Clun and North West Herefordshire Hills (NA58). Phase 2 survey and floristic assessment of U1 grasslands, including outposts in upland areas.

  South Yorkshire, North Yorkshire and Nottinghamshire: Vale of York and Mowbray (NA16), Vale of Pickering (NA18), Humberhead Levels (NA22). Phase 2 survey and floristic assessment of any acid grasslands left in Doncaster heathland areas and in the Vales of North Yorkshire.

- *Low Priority*

  Cumbria: Eden Valley (NA9). Location and condition of characteristic lowland acid grassland species that have been recorded on brown sand areas north of Penrith (**Map 1**).

  Oxfordshire: Midvale Ridge (NA64). Phase 2 surveys of acid grassland remaining on the Midvale Ridge.

  Wiltshire: Thames and Avon Vales (NA63) and Berkshire and Marlborough Downs (NA79). Phase 2 surveys and floristic assessment of any surviving acid grasslands on Greensand and remaining areas in Savernake Forest.

9. Geographical assessment of the nature conservation value of lowland acid grassland in England and the UK and European context for England's acid grassland

9.1 Statutory and non-statutory conservation measures

Lowland dry acid grasslands have not featured prominently in statutory nature conservation evaluations in England compared to other lowland grassland types. In an assessment of numbers of acid grassland SSSIs, NCR sites and NNRs, Jefferson and Robertson (1996) found that the habitat was represented on 12% of NNRs, 11% of NCR sites and 18% of SSSIs, among sites which included lowland grassland. Comparable figures for dry calcareous grassland were 55% of NNRs, 71% of NCR sites and 45% of SSSIs. Figures for dry neutral grassland were 37% of NNRs, 20% of NCR sites and 42% of SSSIs. On a geographical basis lowland acid grasslands were scarcely considered outside of Breckland in the assessment of habitats of national interest published as the Nature Conservation Review (Ratcliffe, 1977).

There are two problems that have probably contributed to the relative lack of attention that the habitat has received in the past. One is semantic; the term acid grassland is associated with some very species-poor habitats in the uplands and if a lowland acid grassland was found to be species-rich then many biologists have called the habitat something else. Fortunately the NVC has introduced much more rigour into habitat description. The second is both semantic and ecological; before the 1960s the term heathland applied to all the open vegetation within the heathland landscape of rough grazings, and the old floras do not recognise a separation between acid grassland and heathland. After the 1960s, heathland rather mysteriously came to mean stands dominated by ericaceous dwarf-shrubs i.e. the 'grouse moor syndrome'. Simultaneously myxomatosis resulted in the crash of rabbit populations. As a result there were declines in most populations of rare and local acid grassland species (Rose, 1995a) and many previously rich acid grasslands became genuinely species-poor.

The preceding chapters in this review have described the significant nature conservation interest of lowland dry grassland. Key features of nature conservation interest are:

- Lowland acid grassland comprises a unique series of plant communities that contribute to the biodiversity of lowland England.
- Lowland acid grassland is far richer in rare and scarce vascular plant species than dry heath.
- Lowland acid grassland shares a threatened bird fauna with dry calcicolous grassland.
- Lowland acid grassland supports rare and scarce invertebrates.
- Lowland acid grassland forms part of the habitat mosaic utilized by rare reptiles and amphibians.
- Lowland acid grassland is an integral part of heathland landscapes and an essential component for their sustainable management by extensive grazing.

There are now a range of measures, as well as statutory site designation, that can be used to conserve lowland acid grassland. The Wildlife Enhancement Scheme on SSSIs provides positive payments to land managers to maintain or restore the wildlife interest of SSSIs. The Coversand WES is an example where acid grassland is benefitting from management under the scheme (see **Volume II**). Several Environmentally Sensitive Areas include acid grassland, in particular the Breckland ESA. Smaller areas occur in others, for example, West Penwith ESA (coastal acid grassland), South Downs ESA (acid grassland on drift overlying chalk) and The Shropshire Hills ESA (parched acid grassland on south-facing hill slopes). Like the ESA scheme, the Countryside Stewardship Scheme offers land managers incentive payments to conserve habitats. The Old Meadows and Pastures landscape type in the scheme is aimed at lowland neutral and acid grassland while the Historic Landscapes includes wood-pasture and parklands that may contain acid grassland (see example in **Appendix 1**). Currently, a Biodiversity Action Plan is being developed for lowland dry acid grassland, which was recognised as a key habitat for conservation in the main report of the UK BAP Steering Group (1995).

9.2 Assessment of lowland acid grassland in England

Implementation of the conservation measures described above requires knowledge of the location, extent and relative nature conservation interest of lowland acid grasslands and the survey priorities given in the preceding chapter attempt to indicate where information is lacking. In the interim, the following assessment of the relative value of different parts of England for acid grassland has been made based on the data collected for this review. It is very provisional and is only intended as a guide. It should be reviewed in the light of further information that becomes available through responses to this report and from additional data collection. Acid grasslands outside the areas below are still likely to be of value in relation to the biodiversity of a county or Natural Area.

The summaries for particular areas include the main conservation issues in those areas. Habitat restoration refers to restoring good habitat condition on existing sites, possibly with some creation of new habitat. Landscape restoration refers to the large scale restoration of functional pastoral landscapes. In many areas some restoration has already commenced. The areas listed below are shown on **Map 24**, and are divided into four categories, plus a list of areas with intrinsic interest as transitions from lowlands to uplands. The Natural Areas within which the acid grassland areas occur are also listed below and shown on **Map 24.**

Category A

The most important areas, which have diverse and usually large scale grass heath or heathland ecosystems with rich acid grassland floras and faunas. The best examples of their type. Includes acid grassland sites of NCR quality. Landscape restoration vital.

A1 Breckland (NA 46)

The premier acid grassland area in the country, with extensive examples of the typical mix of acid grassland communities of eastern England, including blown sand communities. Juxtaposition with calcicolous grasslands and meres. Exceptionally rich flora and fauna, including a typical, if threatened, bird fauna. There is a need to increase grazing levels and on existing grassland and for extensive re-creation of semi-natural habitats (landscape restoration).

A2 The New Forest (NA 77)

The other large surviving area of acid grassland in England and the best example both of acid grassland associated with heath, and of the south-western mix of acid grassland communities and species. Exceptionally rich flora and fauna, including the only stable dry grassland bird assemblage in the lowlands still occupying acid grasslands. Extensive pastoralism survives but may need support in the face of huge social and recreational pressures. There is the potential to reverse the fragmentation caused by 19th century enclosures (landscape restoration).

A3 Dungeness (Kent and Sussex). Romney Marshes (NA 71)

The best example of acid grassland on a coastal shingle structure and nationally the largest stands of lichen-rich parched acid grassland (U1a). Breeding Wheatear present. Much past damage, and long term potential for restoration needs considering (landscape restoration).

A4 The Dorset Heaths (NA 81) and Isles of Portland and Purbeck (NA 82)

Much damaged by lack of grazing management but still harbours an exceptionally rich flora and is an integral part of very important and still quite extensive heathland. Corfe Common is an exceptional south-western acid grassland site in its own right. Extensive landscape restoration is vital for retrieving these heathlands.

A5 West Wealden Heathlands (Surrey, Hampshire and Sussex). Wealden Greensand (NA 70)

Large scale heathland ecosystems survive with rich grasslands, transitional between southern and eastern heathlands. Very rich flora including lichens.

A6 South coast of Devon and Cornwall. South Devon (NA 91) and Cornish Killas and Granites (NA 95)

The coast between Start Point and Looe encompasses the best south-western cliff top acid grasslands, including a superb ephemeral flora. Landscape restoration of the wider grassland habitat here and elsewhere in the south-west is necessary if Chough is to re-establish in England.

A7 Sandlings and Suffolk Coast. Suffolk Coast and Heaths (NA 49)

Similar to Breckland but acid grassland less extensive and calcicolous grassland absent. As well as the grass heaths, parched acid grassland frequent on the inland side of shingle structures. Rich flora and relic dry grassland bird fauna. Landscape restoration essential.

A8 Solent Coast (Hampshire and Isle of Wight) (NA 76). South Coast Plain and Hampshire Lowlands (NA 75) and NA 76.

Includes St Helen's Duver, the most species-rich, coastal dune, acid grassland recorded, and several other coastal sites on shingle structures, dunes and cliff tops with collectively a very rich flora. Habitat restoration more important than landscape restoration.

A9 Welsh and Shropshire Hills (Shropshire, Radnorshire and Montgomeryshire). Shropshire Hills (NA 42) and Clun and North West Herefordshire Hills (NA 58)

A scatter of small sites, the best of which are in Wales, including Craig Breidden. The area includes the richest and most well developed examples of parched acid grassland on rock outcrops and associated chasmophytic vegetation. Habitat restoration more important than landscape restoration.

A10 Coversand Heaths (South Humberside, Lincolnshire and Nottinghamshire). North Lincolnshire Coversands and Clay Vales (NA 34) and Trent Valley and Rises (NA 33)

Much fragmented and degraded in the past, but one of the few areas outside Breckland containing blown sand communities and calcicolous grassland as well as acid grassland. Recent WES restoration and Countryside Stewardship acid grassland creation have enhanced the value of this area. Previous information indicated that the area was too degraded to be included in category A but surveys as part of this review showed it had considerable value (see **Appendix 1**). Risby Warren is an exceptional site in its own right with over 50ha of U1c and mobile sand dunes. The area is one of the most floristically rich areas of acid grassland north of the Bristol to Wash line. Landscape restoration essential.

Category B

The following list of areas are either less diverse than those in Category A, but still rich in some groups, or represent less extensive ecosystems. However, they remain vital to the national biodiversity and the national distribution of the acid grassland resource. Includes the best outlying stands. May include sites of NCR quality for their acid grasslands. Landscape restoration a very high priority.

B1 Thames Valley Heaths (Surrey, Hampshire and Berkshire). London Basin (NA 66)

Includes a southern rather than eastern mix of acid grassland communities, which are associated with heathland and river terraces. Collectively a rich flora survives but the area is much damaged by fragmentation and neglect. Windsor Park includes outlying stands of moist acid grassland (U4) associated with ancient trees and rich grassland fungi floras. Landscape restoration essential. Greenham Common is an exceptional site in its own right.

B2 Kidderminster Heaths: (Hereford and Worcester, Shropshire, Staffordshire). Midlands Plateau (NA 43)

A floristically rich area of acid grassland north of the Bristol to Wash line. It includes outlying examples of the eastern mix of communities and species. Habitat and landscape restoration required.

B3 Malvern Hills and Castlemorton Common (Hereford and Worcester). Malvern Hills and Teme Valley (NA 57)

Includes acid grassland on thin soils over rock, and associated extensive acid grassland. Interesting flora with some south-western species at the limit of their range. Wheatear bred until recently. Pastoral system collapsing and landscape restoration required.

B4 Northumberland Whin Sill. North Northumberland Coastal Plain (NA1) and Border Uplands (NA 2)

Well-developed examples of parched acid grassland on shallow soils on igneous outcrops with a rich flora in an area far from the main concentrations of acid grassland. The best *Thero-Airion* vegetation on rock in England but not as important as the eastern Welsh sites. Habitat restoration required.

B5 Cornish coast from St Austel to Hartland Point. Cornish Killas and Granites (NA 95), West Penwith (NA 96) and The Lizard (NA 97)

The internationally important Lizard heathland and coastal cliffs includes very important maritime therophyte grasslands (MC5) but the area of U1f cliff top acid grassland is apparently much more limited. However, the west and north of Cornwall does include good stands of cliff top acid grassland as a part of important habitat complexes. There is a need to evaluate the lowland Agrostis curtisii (U3) grasslands of the south-west in general. These have a high intrinsic interest due to international rarity and if the best examples, once located, are included here in an expanded area, such an area might merit Category A status. Landscape restoration a priority for coastal grasslands to provide Chough habitat.

Category C

Areas which are somewhat degraded, usually by habitat fragmentation, in comparison to the categories above, but which are significant in terms of the national distribution of acid grassland resource. The potential for habitat and landscape restoration to enhance the national significance of these areas is high. Most good quality stands should ideally be included within SSSIs. Landscape restoration a priority in most areas.

C1 North Norfolk (NA 47)

An eastern area which has lost most of its acid grassland to habitat destruction. The formerly rich flora and fauna has seriously declined. Landscape restoration essential if this conservation value is to be restored.

C2 Waveney and the Broads (NA 48) and East Anglian Plain (NA 50)

An eastern area with acid grassland found on river terraces and in sandy areas of flood plains. It has lost much of its acid grassland to habitat destruction but a rich flora has been recorded quite recently and local survival of acid grassland is indicated. Landscape restoration essential.

C3 Kent, north of the Downs. North Kent Plain (NA 68)

Consists of small and fragmented sites but a quite rich flora recorded overall. Habitat restoration required.

C4 Kent, Greensands. Wealden Greensand (NA 70)

Consists of small and fragmented sites with some larger parklands and a heathland with a relatively rich flora recorded overall. Habitat restoration required.

C5 Devon Redlands (NA 90)

Includes surviving heathlands with a fairly rich surviving grassland flora. Habitat or, ideally, landscape restoration required.

C6 North east Essex. London Basin (NA 66)

Very fragmented remains of former heathlands which have suffered high loss of acid grassland flora. Landscape restoration required.

C7 Midvale Ridge (NA 64) (Oxfordshire)

Once contained important outlying stands of eastern type acid grassland. Several small fragments with scarce species survive but are highly fragmented. Landscape restoration urgent. The best surviving area, Frilford Heath is still of considerable significance.

C8 Bedfordshire Greensand (NA 53) (Bedfordshire, Cambridgeshire and Buckinghamshire)

Very fragmented remains of former heathlands which have lost many acid grassland plant species. Landscape restoration required.

C9 Humberhead Levels (NA 22) (South Yorkshire, Nottinghamshire and North Yorkshire)

Very fragmented remains of former heathlands which have suffered heavy losses of acid grassland flora. Landscape restoration required.

C10 Sherwood (NA 32) (Nottinghamshire)

Very fragmented remains of former heathlands with a moderately rich flora. Sizeable patches of U2 grasslands survive but parched acid grasslands appear to have been much reduced. Landscape restoration required.

C11 Lincolnshire, Ancaster Area. Lincolnshire and Rutland Limestone (NA 38)

Very highly fragmented remains of former plant communities on blown sand, associated with limestone grass heaths. A moderately rich flora survives including rare species. Landscape restoration required.

C12 Sefton Coast, Merseyside. Urban Mersey Basin (NA 26)

Areas of acid grassland with some southern acid grassland species associated with very rich and important dune systems. Habitat restoration required in overall complex.

C13 Dartmoor (NA 92) (Devon)

Surprisingly rich lowland acid grassland flora on the fringes of the extensive system of moorland commons.

Category D

Areas of importance to biodiversity at a county level in terms of the acid grassland habitat. Ideally all areas should include SSSIs containing representative stands of acid grassland. Habitat restoration usually essential but areas are of lower priority for landscape restoration.

D1 Avon Commons. Bristol, Avon Valleys and Ridges (NA 62)

Small fragments of parched acid grassland with locally uncommon species.

D2 Cumbria, north of Penrith. Eden Valley (NA 9)

Concentrations of characteristic lowland acid grassland plants have been recorded from this area but their current condition is unclear.

D3 Sussex, High Weald (NA 72)

Much heathland and pasture woodland has been lost to enclosure. Extensive under-grazed heathland survives in Ashdown Forest but the acid grassland flora appears to have always been poor.

D4 Forest of Dean. Dean Plateau and Wye Valley (NA 61)

Pasture woodland and heathland complex mostly destroyed by conversion to plantation but interesting range of acid grasslands associated with forest clearings, coal waste and neutral grasslands in small fields. The area includes an important grassland fungi site. Landscape restoration could greatly increase the value of the area.

D5 Leicestershire, Charnwood (NA 39)

Relic heathland and parkland with some lowland acid grassland features. Interesting transition to upland grassland.

D6 Leicestershire, Trent Valley and Rises (NA 33)

A few lowland acid grassland sites survive in this area and are important for the county's biodiversity.

D7 Wiltshire, Spye Park and Savernake areas. Thames and Avon Vales (NA 63) and Marlborough and Berkshire Downs (NA 79)

Small areas of relic acid grassland contribute to the county's floristic diversity. Savernake Forest includes relic areas of pasture woodland and is a high priority for landscape restoration.

D8 Northamptonshire Acid Grasslands. Midlands Clay Pastures (NA 44)

Contains tiny relicts of heathland with acid grassland which are important to the floristic diversity of the county.

Lowland/Upland Transition Areas

The following areas contain essentially lowland acid grasslands in a largely upland or upland fringe environment, and have intrinsic interest in representing the transition from lowland to upland conditions, irrespective of their value for lowland acid grasslands. See the county accounts in **Volume II** for more details and also the categories above.

Leicestershire, Charnwood Forest (see D5)

Staffordshire, Cannock Chase

Cumbria, north of Penrith (if still present) (see D2)

Cumbria, southern Lake District

Shropshire Hills (see A9)

Northumberland Whin Sill (see B4)

Dartmoor (see C13)

9.3 United Kingdom context

9.3.1 Introduction

England has the bulk of the lowland dry acid grassland resource of the UK. Estimates for the extent of the habitat in Wales and Scotland are given below. Northern Ireland does not appear to have well-developed examples of lowland dry acid grassland. (Paul Corbett, Environment and Heritage Service pers comm).

9.3.2 Wales

Dry acid grasslands are likely to be widespread in the lowlands of Wales with a total of 421ha of dry acid grasslands recorded by Phase 2 surveys in Wales. This total is mostly made up of Festuca-Agrostis-Galium grassland, U4, with less than 1 ha of Deschampsia flexuosa grassland (U2) and 10 ha of parched acid grassland (Festuca-Agrostis-Rumex grassland, U1). (Dr Carrie Rimes, Countryside Council for Wales, pers. comm.) An overall estimate for lowland acid grassland (excluding upland fringes) is 2,000ha (Dr David Stevens CCW pers. comm). The distribution of characteristic acid grassland species (**Maps 2** to **4**) show that these occur in two situations, on the coast and in the eastern hills where the accumulated moisture deficit is greater than 100mm (**Map 18**) (Bendelow and Hartnup 1980).

Over most of Wales, with its low moisture deficit, the lowland acid grassland flora is poorly developed. The coastal flora includes *Agrostis curtisii* in the Gower, and other south-western species include *Chamaemelum nobile, Lotus subbiflorus, Erodium maritimum, E. moschatum, Trifolium ornithopodioides* and *Viola lactea.* There is a strong possibility that there are some interesting examples of the south-western types of acid grassland including Agrostis curtisii grassland (U3) and Festuca-Agrostis-Rumex grassland Hypochaeris sub-community (U1f) in coastal habitats, including heathland and cliff top grassland.

In the east there are two spectacular sites on basic igneous rocks at Stanner Rocks, Radnorshire and Craig Breidden, Montgomeryshire. Woods (1993) gives an excellent NVC based account of grasslands in Radnor. The most widespread forms of parched acid grassland (U1) is the Potentilla-Galium sub-community (U1c) found on shallow, dry, soils on banks in heaths and within larger areas of moist acid grassland (U4). On road banks and church yards the Anthoxanthum-Lotus sub-community (U1d) also occurs widely. On extremely heavily grazed commons in central and east Radnor the quite extensive areas of the Typical sub-community (U1b) are associated with ephemeral ponds, which harbour what are probably the largest stable populations of *Pilularia globulifera* in Britain outside the New Forest.

On bare and rocky ground, richer stands related to the Erodium-Teesdalia sub-community (U1c) with species such as *Moenchia erecta, Filago minima, Dianthus deltoides* and *Teesdalia.* Stands of the Hypochaeris sub-community (U1f) are noted on rock outcrops, with *Sedum anglicum.* On Stanner Rocks both U1c and U1f and related chasmophytic communities occur with a remarkable selection of national rarities and local species: *Scleranthus perennis perennis, Trifolium strictum, Lychnis viscaria, Veronica spicata, Sedum fosterianum* and *Geranium sanguineum.* Stanner Rocks and Craig Breidden are the best examples of U1 type communities on basic igneous outcrops in Britain. Otherwise the acid grasslands of the east of Wales are similar to those of Shropshire.

Moist acid grassland (U4) is mainly upland in character but the Holcus-Trifolium sub-community (U4b) extends into the lowlands. Important, species-rich, enclosed meadows have been described as U4c (data provided by Dr David Stevens CCW) but these could perhaps equally well be described as acidic MG5c. They have *Centaurea nigra* as a constant and the typical herb assemblage of *Succisa, Stachys officialis, Lotus corniculatus* and other species. Only the presence of *Festuca ovina* at constancy level V distinguishes these stands from what would be described as herb-rich, low productivity, MG5c in areas such as Hampshire.

9.3.3 Scotland

The extent and character of lowland acid grasslands is less well known than in Wales but there is thought to be less than 5,000 ha in total (Jane MacKintosh, Scottish Natural Heritage, pers. comm.). In a review of Scottish NVC surveys, Cooper and MacKintosh (1996) found that U1, U2 and U4 were all recorded from Scotland. Several surveys in eastern Scotland, notably the Borders, found U1d. Along shingle riverbanks of Tayside and Deeside, vegetation descriptions suggested that communities similar to Ulb and Ulc might be present, although there was insufficient information available to be certain. These records for U1 extend the distribution of the community in Britain beyond that described by the published NVC (Rodwell 1992). A few surveys recorded U2, mostly U2a, on the upland fringes. U4 was also recorded in upland fringes, particularly somewhat improved U4b. Occasionally U4a and U4c were recorded. The authors report that, although the U4c sub-community was only sampled in the Derbyshire Dales in the published NVC, it has been recorded more widely, and some records were made in Scottish surveys.

In Scotland the characteristic lowland acid grassland flora (**Maps 2** to **4**) has been recorded mainly from areas with an accumulated moisture deficit of more than 75mm (**Map 18**) (Birse & Dry, 1970) with smaller concentrations of species recorded from river valleys in the Highlands. In some areas these species are found in coastal dune systems and on river gravels but in the south-east they are also found on outcrops of volcanic basalt, andesite and tuffs in areas such as the Sidlaw Hills, Moncrieff Hill south of Perth, and Arthur's Seat, Edinburgh. From personal experience (NA Sanderson) these rocks can support communities related to parched acid grassland Festuca-Agrostis-Rumex grassland (U1) and calcicolous grassheath Festuca-ovina Hieracium pilosella-Thymus praecox grassland (CG7). These acid grasslands probably represent some of the northern-most occurrences of this type vegetation and they are thus likely to be of high intrinsic interest.

9.4 European context

The following brief review attempts to set the lowland dry acid grasslands of England in a European context, although there is relatively little information readily available on European grasslands.

9.4.1 Vegetation

Rodwell (1992, 1996) provides an analysis of the European phytosociological affinities of the NVC communities. These European affinities are described below, and related to the Corine Biotope Classification (Commission of the European Community, 1991) and the Interpretation Manual of the European Habitats (EC DGXI 1995) which defines Annex 1 Habitat Directive types.

***Festuca ovina - Agrostis capillaris - Rumex acetosella* grassland (U1)**

Rodwell (1992) regards U1 as being included within the *Sedo-Sceleranthetea* class of vegetation of dry sandy soils and thin soils over rock, and within this, as being best placed in the *Thero-Airion* alliance. Rodwell (1996) includes U1 in the *Koelerio-Corynephoreta* class and the *Plantagini-Festucion ovinae* alliance, rather than the *Thero-Airion* alliance. Related associations within the *Thero-Airion* alliance (*sensu* Rodwell 1992) are recorded from the Netherlands, Germany and Poland. *Aira praecox* itself is an endemic western European species extending to south-west Finland, the Czech Republic and north-west Italy (Sell & Murrell 1996). The *Thero-Airion* appears to be mainly a feature of warm Atlantic and sub-Atlantic climates where summer droughts occur consistently, winter growth is possible and leaching is significant. It seems to be associated with heathlands and inland blown sand deposits. It has few affinities with steppe communities which are typical in areas where calcium carbonate accumulation becomes more significant than leaching and winter growth is not possible.

The *Thero-Airion* is included in Corine under Dry Siliceous Grasslands (35) as 35.2 Medio-European Open Siliceous grasslands, either as 35.21 Dwarf Annual Siliceous Grasslands or 35.22 Perennial Open Siliceous grasslands. These types are open formations on dry siliceous soils of Atlantic, sub-Atlantic and Mediterraneo-montane distribution. They are often species-poor and have a strong representation of annuals. The *Sedo-Sceleranthetea* in Corine is listed under Dry Calcareous Grasslands and Steppes (34) as 31.4 Middle European Pioneer Swards, which are open, thermophilic formations on sandy or rocky ground, in non-Mediterranean lowland to montane areas. U1 grassland is not listed on Annex 1 of the Habitats Directive (92/43 EEC).

Deschampsia flexuosa grassland (U2)

Rodwell (1992) regards Deschampsia flexuosa grassland (U2) as being best placed within the *Nardo-Galion* alliance of the *Nardo-Callunetea* class. Whilst the driest stands have some *Thero-Airion* features, these cannot be considered as typical of this alliance. Rodwell (1996) places U2 in the *Nardo-Callunetea* class but in the *Violon caninae* alliance, which covers unfertilized mat-grass pastures at lower altitudes. Deschampsia flexuosa grasslands are listed in Corine as 35.13 Deschampsia flexuosa Grasslands under 35.1 Atlantic Matgrass Swards and Related Communities. Although U2 is within 35.1, it is not a habitat listed under this category in Annex 1 of the Habitats Directive. In Britain, species-rich examples of CG10 and CG11 are regarded as representing type 35.1, and only occur in upland areas.

Deschampsia flexuosa is a cosmopolitan species widespread across temperate Eurasia and mountains in the south of North America (Sell & Murrell 1996). In Europe it is found on dry acidic soils in boreal and temperate forests and is a typical component of heath and acid grasslands derived from these woods (Polunin & Walters, 1985).

Agrostis curtisii grassland (U3)

Rodwell (1992) does not directly suggest phytosociological affinities for U3 but implies that it belongs within the *Nardo-Galion* alliance. Its position appears similar to U2, with the driest stands transitional to *Thero-Airion* but the bulk firmly within the *Nardo-Galion*. Rodwell (1996) places U3 in the *Violion caninae*.

The community is not identified in Corine but presumably should be included under the 35.1 Atlantic Matgrass Swards and Related Communities. *Agrostis curtsii* is confined to south-west Europe and north Africa (Sell & Murrell 1996), where it is mainly found as a component of heathlands. *Agrostis curtsii* grasslands are commonly regarded as having been derived from heath (Rodwell, 1992) and, because of this perception, do not appear to be considered as a separate type. Some New Forest U3 grasslands, however, are relatively stable communities, found on brown earths as opposed to the podzols found under *Agrostis curtsii* heaths (H3). These New Forest examples have probably remained distinct from heath for hundreds of years. The extent of these stable *Agrostis curtisii* grasslands in Europe, as opposed to recently derived grasslands, is totally unknown. U3 is not an Annex 1 Habitats Directive type.

Festuca ovina - Agrostis capillaris - Galium saxatile grassland (U4)

Rodwell (1992) regards U4 as clearly referable to the *Nardo-Galion* (*Violion caninae* in Rodwell 1996). In Corine, U4 is include within 35.12 Agrostis-Festuca grasslands, under 35.1 Atlantic Matgrass Swards and Related Communities. There appear to be few equivalents to these *Festuca-Agrostis* swards in continental Europe. U4 is not an Annex 1 Habitats Directive type.

Carex arenaria communities

The Carex arenaria dune community (SD10) is regarded by Rodwell (in prep) as having greatest affinities with the *Ammophilion* alliance, and in Rodwell (1996) it is referred to the *Ammophilion arenariae*, vegetation of young to fixed dunes, within the *Ammophiletea arenariae* class. In Corine, *Carex arenaria* grasslands are described as being closed, acidophilous grasslands, on fixed sands dominated by Carex arenaria (35.15). It is not an Annex 1 type. Rodwell (in prep) regards the Carex arenaria-Cornicularia aculeatam community (SD11) as best included within the *Corynephorion* alliance. Rodwell (1996) places SD11 in the *Koelerio-Corynephoretea* class, along with U1, and in the *Corynephorion canescentis* alliance. The *Corynephorion* is found on acid coastal and inland sands from the Netherlands into Poland. Corynephorus grasslands are included in Corine as 35.23 within

35.2 Medio-European Open Siliceous Grasslands and also 64.11, inland dune, pioneer, grasslands under fluvio-glacial inland dunes (64.1)

Corynephorus may also in occur in Corine type 64.2, Breckland inland dunes. SD11 forms part of an Annex 1 type called Open Grassland with *Corynephorus* and *Agrostis* of Continental Dunes (64.1 and 35.2). The Interpretation Manual (EC DGXI 1996) also includes SD12 in this type. However, only examples of the Annex 1 type with Corynephorus have been proposed as Special Areas for Conservation in the UK and one site has been selected in Breckland (Brown *et al* 1997).

Other communities

Acid grasslands more typical of the uplands, Nardus stricta - Galium saxatile grassland (U5), and Juncus squarosus - Festuca ovina grassland (U6) are placed in the *Nardo-Callunetea* class by Rodwell (1992, 1996). In Rodwell (1992), U5 is in the *Nardo-Galion* alliance (re-named *Violion caninae* in Rodwell 1996), while U6 is in the *Juncus squarrosi* (*Nardo-Juncion squarrosi* in Rodwell 1996). In Corine, U5 is within 35.11 Mat-Grass Swards, while U6 is within 37.3 Oligotrophic humid grasslands. Neither is an Annex 1 type.

Pteridium aquilinum - Galium saxatile stands (U20) do not feature in Europe according to Rodwell (1992). Rodwell (1992, 1996) places U20 in the class *Quercetea robori - petraeae* class, *Quercion robori-petraeae* alliance, as it seems to be best regarded as an anthropogenically derived replacement for oak and oak-birch woodland on acid soils. The Corine type for these woodlands is 41.5 Acidophilous Oak Forests. Bracken stands are not an Annex 1 type.

9.4.2 Extent of lowland acid grassland in Europe

Two reports which refer to the extent of dry grasslands in Europe were consulted. Wolkinger and Plank (1981) provided little information of use. For them dry grassland is synonymous with calcicolous grassland (class *Festuco-Brometea*). *Sedo-Scleranthetea* vegetation is only briefly mentioned.

Van Dijk (1991) reviewed the status of semi-natural grasslands in Europe. His review indicated a general lack of data on acid grassland but what information could be obtained was described. In the entry for Great Britain, the acid grasslands (order *Nardetalia*) of the uplands are assumed to be important, due to them being very rare in the lowlands of the continent. No mention is made of *Sedo-Scleranthetea* vegetation in Britain.

For Germany, interesting information exists for the individual Länder. In Lower Saxony, acid grasslands i.e. *Corynephorion*, *Thero-Airion*, *Armerion elongatae* and *Violo-Nardion* (*Nardo-Galion*) covered only 1,048ha scattered over 110 sites. In Nordrhein-Westfalen, acid grasslands (order *Nardetalia*) are recorded as covering 38ha with reports of a great decline in area. The *Nardo-Galion* is regarded as having practically disappeared. Baden-Württemberg still has 11,500ha of acid grasslands (order *Nardetalia*) and in Bavaria there are 4,409ha of acid grasslands (type unknown).

For France, little information is available but 5,000ha of species rich acid grassland with abundant *Arnica montana* is mentioned as being under threat in the High Vosges. The 100,000s of hectares of species-rich *Nardus* grassland of the Massif Central, however, are not mentioned. For a illustration of the extensive nature of this habitat see plate 21 in Polunin & Smythies (1988). No other useful information was given.

No very definite conclusions can be made from this information as *Sedo-Scleranthetea* vegetation has hardly been recorded and appears to be rare now in the western European lowlands. *Nardo-Galion* vegetation is very restricted in the lowlands due to loss of habitat and is also threatened in the uplands, although more extensive stands exist here. The impression gained from existing information is that the

Sedo-Scleranthetea vegetation of lowland England is very significant in terms of its extent in a European context.

9.4.3 Flora

A detailed biogeographical account of the British and Irish flora has recently been published (Preston and Hill 1997). In this paper species are classified by their occurrence in one or more major biomes (north to south: Arctic, Boreal, Temperate, Southern) and their longitudinal distribution (west to east: Oceanic, Suboceanic, European, Eurosiberian, Eurasian, Circumpolar). The combination of these categories gives 43 floristic elements. The species listed in Table 1 as being those generally faithful to lowland acid grassland in England are categorised by Preston and Hill as follows:

European Boreo - Temperate

Thymus serpyllum

Eurosiberian Boreo - Temperate

Dianthus deltoides

Oceanic Temperate

Festuca longifolia
Viola lactea

Suboceanic Temperate

Ornithopus perpusillus

European Temperate

Filago minima
Sagina subulata
Scleranthus perennis
Teesdalia nudicaulis
Vicia lathyroides

Eurosiberian Temperate

Herniaria glabra
Potentilla argentea
Veronica verna

Suboceanic Southern - Temperate

Chamaemelum nobile
Erodium maritinum
Lotus subbiflorus
Moenchia erecta
Trifolium ornithopodioides

European Southern - Temperate

Corynephorus canescens
Hypochaeris glabra
Lotus angustissimus
Trifolium striatum

Eurosiberian Southern - Temperate

Apera interrupta
Medicago minima
Silene conica
Stellaria pallida

Mediterranean - Atlantic (includes eastern Mediterranean)

Gladiolus illyricus
Trifolium glomeratum
Trifolium suffocatum
Vulpia ciliata

Submediterranean - Subatlantic (includes south-western parts of Central Europe)

Crassula tillaea
Trifolium scabrum
Trifolium subterraneum

Compared to the total flora of Britain and Ireland there is a much greater representation in Table 1 of Southern Temperate (39.4% *vs* 20%) and Mediterranean elements (21.2% *vs* 7.9%). This finding fits with the lowland habitat characteristics of parched acid grassland in England, especially relatively low summer rainfall and/or freely draining substrates. There is also a greater representation of Oceanic and Suboceanic species in Table 1 compared to the flora as a whole (21.2% *vs* 12.6%). This western character of the parched acid grassland flora in England is probably more significant in terms of European biogeography than the 'continental' element of this flora, which is best developed in Breckland. Preston and Hill (1997) identify 'continental' species as those rare in the Oceanic zone of Europe. Only three species (*Dianthus deltoides, Thymus serpyllum* and *Veronica verna*) are classed as 'continental' among the species in Table 1.

The sub-species *Scleranthus perennis prostratus* of eastern England is endemic (Stace 1991) and *Vulpia ciliata ambigua* is a near-endemic, being confined to a few localities in Belgium and north-west France in mainland Europe (Sell and Murrell 1996).

10. Acknowledgements

This project was funded under EN Contract No. VT2.1C. The author is especially grateful for the very helpful input from English Nature's Local Team staff and other conservationists, in particular Dr Francis Rose, Ted Green, Simon Leach, Colin Newlands, Nick Hodgetts, Brian Edwards, Paul Edgar, Dr Colin Pope, Mark Crick, Tim Smith, Clive Chatters, Paul Darby, Christine Bennett and Paul Gately. In addition to these people, the author particularly thanks the landowners and occupiers for their permission to visit sites, and national specialists in English Nature, Phil Grice, Ron Porley, Ian Taylor, David Sheppard, Martin Drake, Tony Gent and Heather Robertson for their useful ideas and information. In addition staff from the other country agencies provided helpful information, in particular Carrie Rimes and David Stevens of the Countryside Council for Wales, Jane MacKintosh of Scottish Natural Heritage, Paul Corbett of the Environment and Heritage Service, Northern Ireland, and Henry Arnold of the Biological Records Centre.

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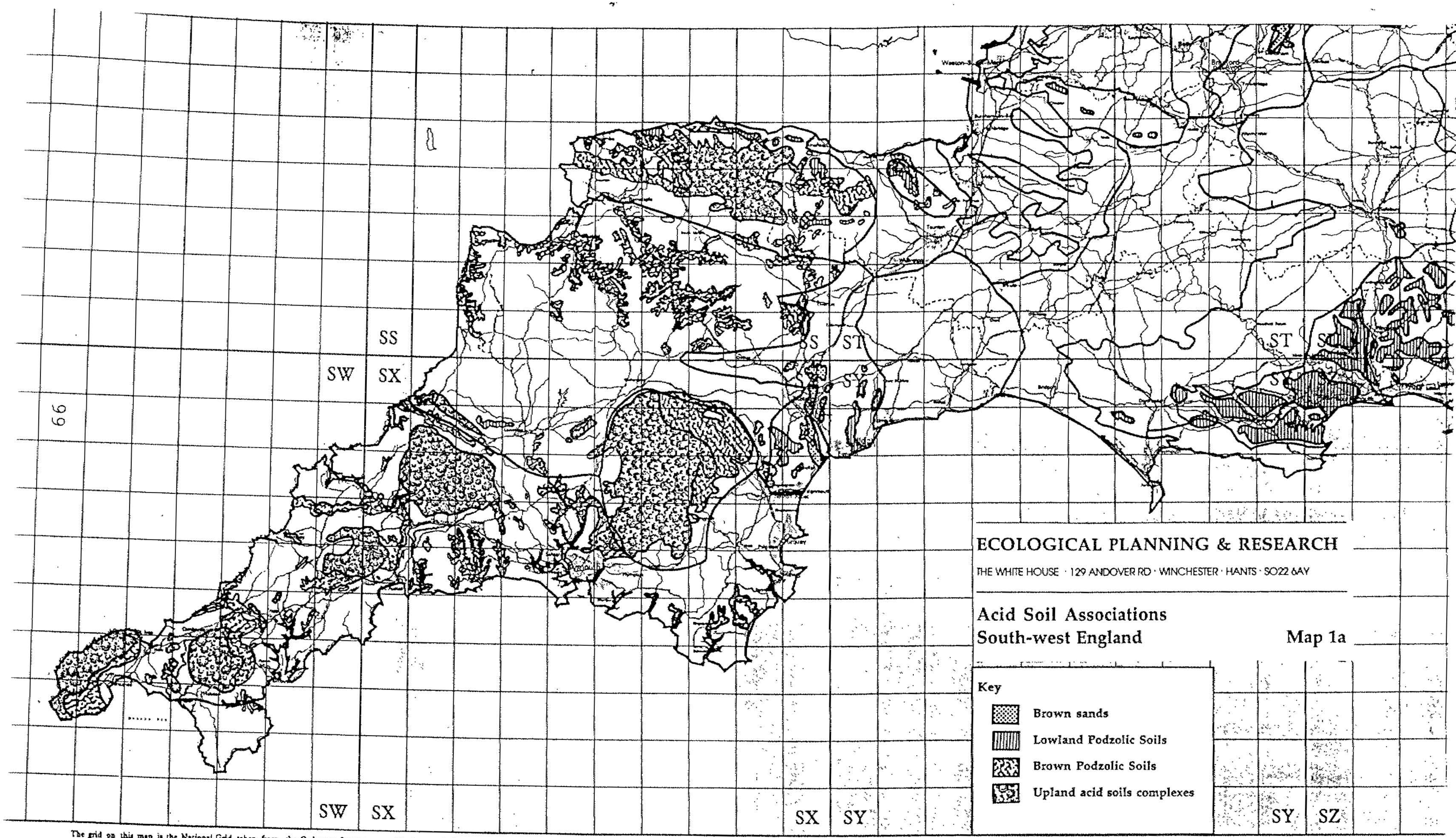
Maps

Map 1 Acid soil associations in England

The following six maps show generalised acid soil associations for England.


SS
SW
SX
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ST
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SW
SX
SX
SY
ST
S
S
SY
SZ
Weston-s-Mare
Key
▩ Brown sands
▥ Lowland Podzolic Soils
▨ Brown Podzolic Soils
▦ Upland acid soils complexes
3
4

ECOLOGICAL PLANNING & RESEARCH

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Acid Soil Associations South-west England

Map 1a

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Administrative boundaries are WARD-LINE Copyright and Crown Copyright and are derived from the 1991 Census of Population
Background detail is derived from the Automobile Association's Automapa dataset. AA © The Automobile Association 1991

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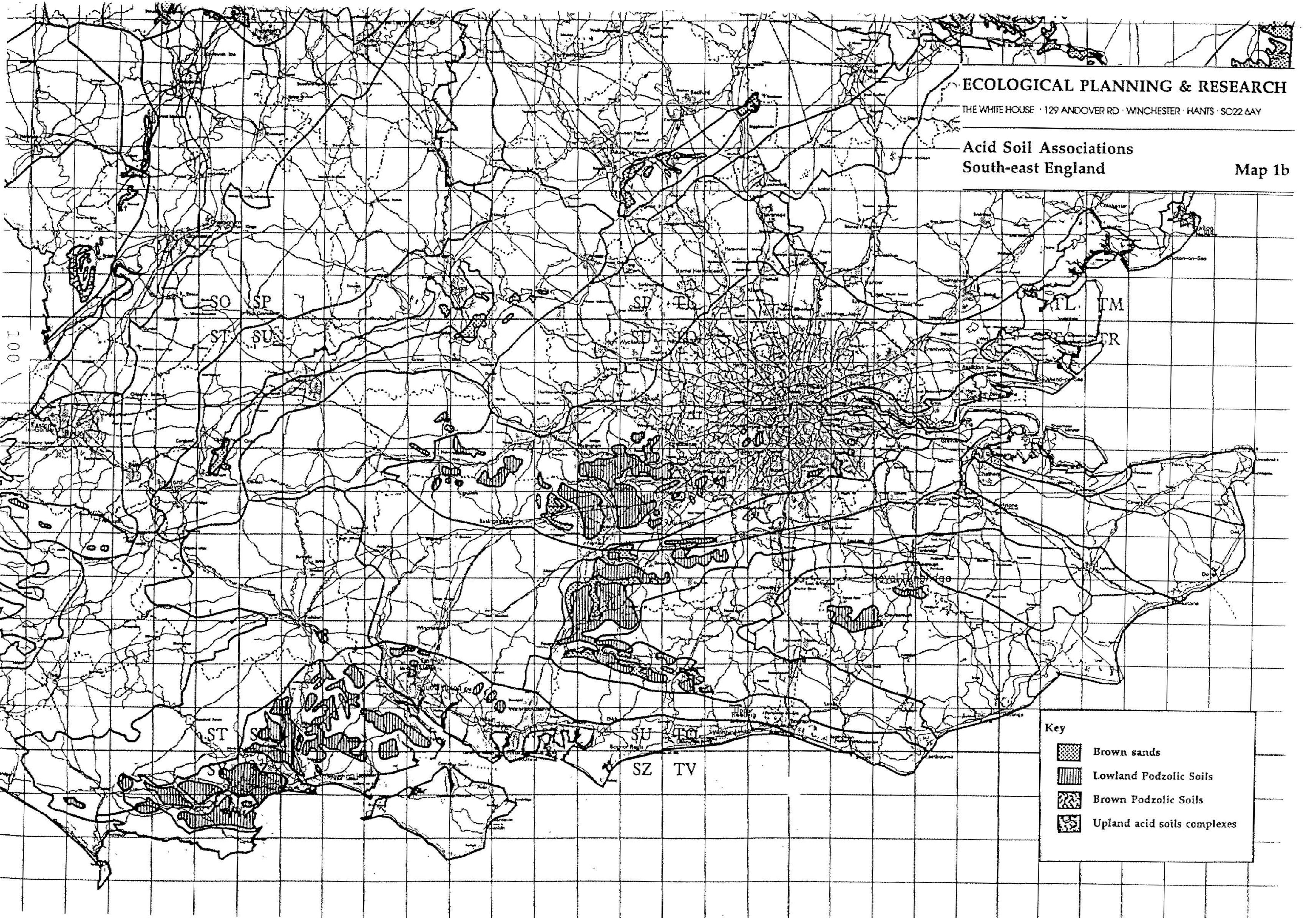

SO
SP
SP
TL
TL
TM
ST
SU
SU
TQ
TQ
TR
ST
SU
SU
TQ
SY
SZ
SZ
TV

ECOLOGICAL PLANNING & RESEARCH

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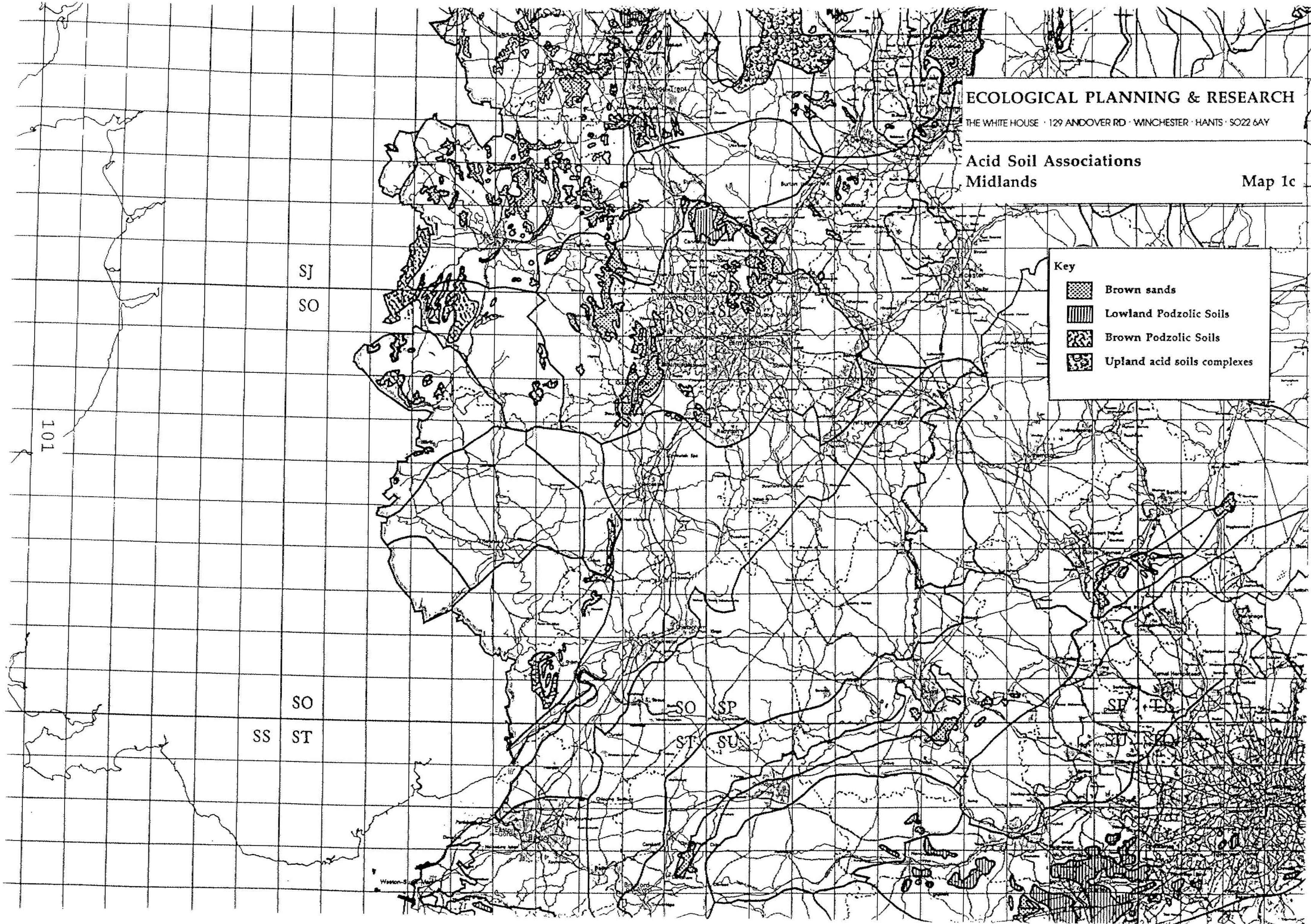
Acid Soil Associations South-east England

Map 1b

Key

▩	Brown sands
▥	Lowland Podzolic Soils
▦	Brown Podzolic Soils
▣	Upland acid soils complexes


SJ
SO
SO
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ST
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SK
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SP
SO
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ST
SU
SP
TL
SU
TQ
Key
▩ Brown sands
▥ Lowland Podzolic Soils
▨ Brown Podzolic Soils
▧ Upland acid soils complexes

ECOLOGICAL PLANNING & RESEARCH
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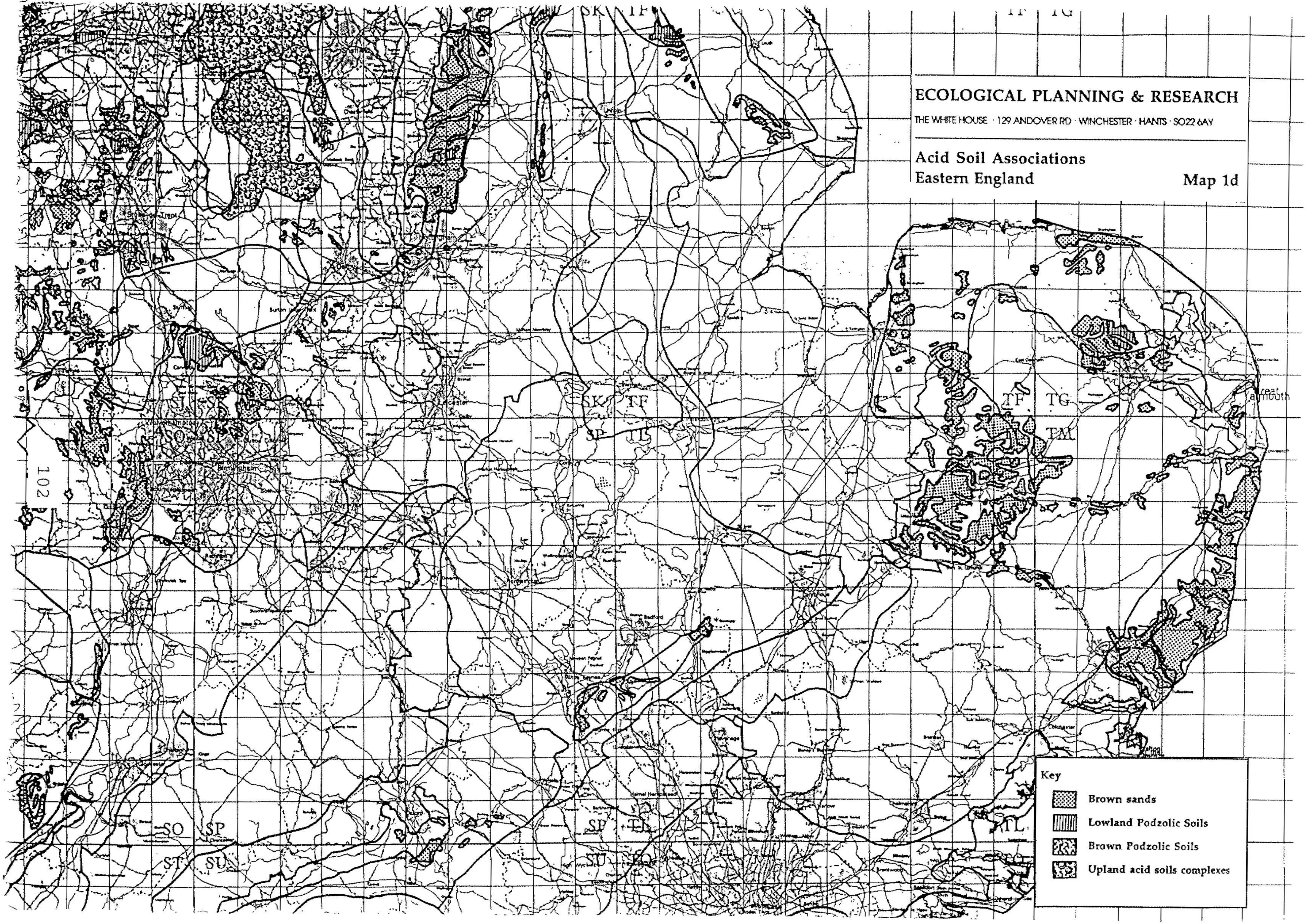
Acid Soil Associations
Midlands
Map 1c


SK
TF
TG
SJ
SK
SO
SP
SK
TF
SP
TL
TF
TG
TM
Great Yarmouth
Birmingham
Wolverhampton
Nottingham
Leicester
Northampton
Bedford
Cambridge
Colchester
SO
SP
ST
SU
SP
TL
SU
TQ
TL
TQ

ECOLOGICAL PLANNING & RESEARCH

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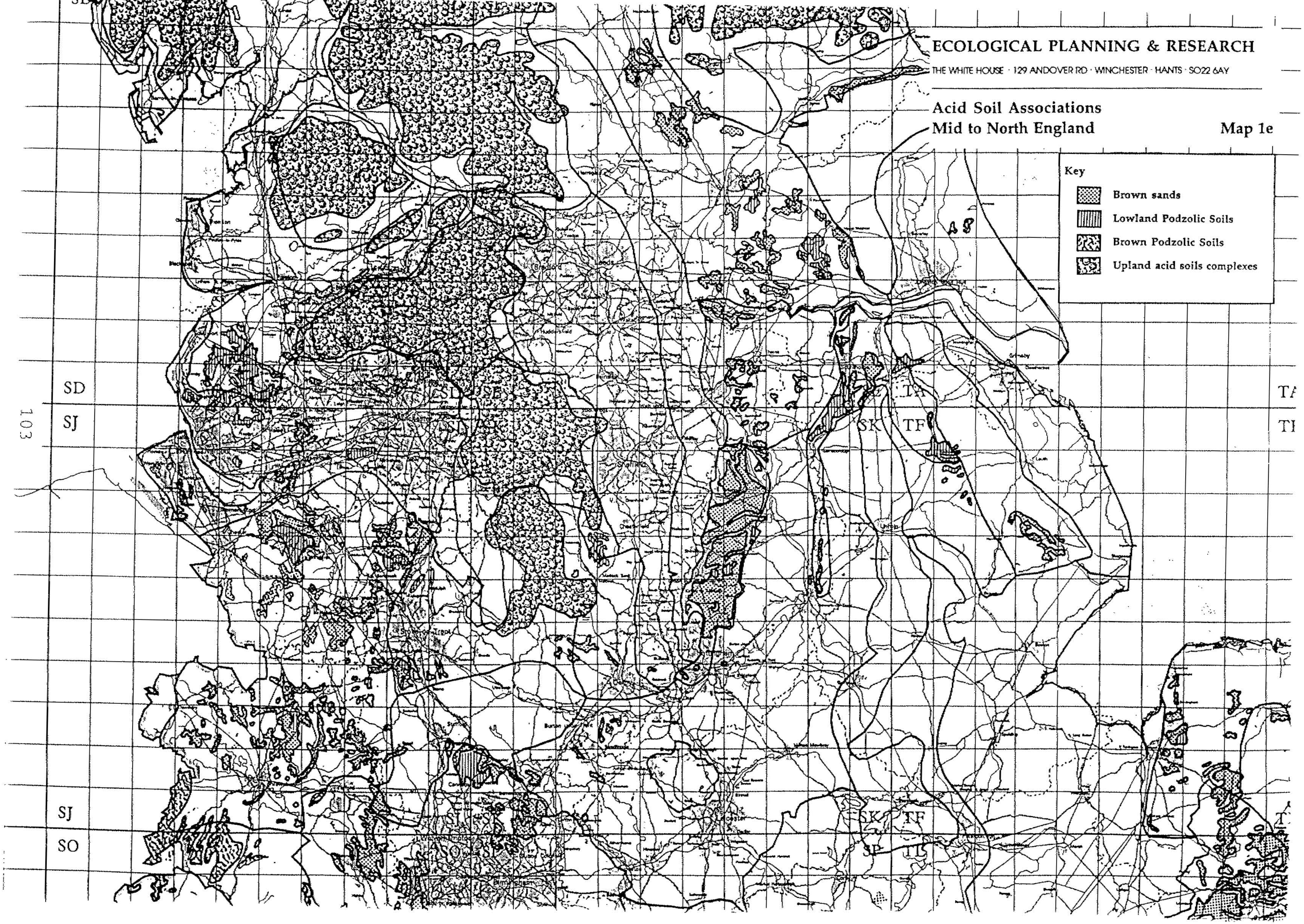
Acid Soil Associations
Eastern England **Map 1d**

Key

▩	**Brown sands**
▥	**Lowland Podzolic Soils**
▦	**Brown Podzolic Soils**
▧	**Upland acid soils complexes**


SD
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SJ SK
SE TA
SK TF
TA
TF
SJ
SO
SJ SK
SO SP
SK TF
SP TL
Stoke-on-Trent

ECOLOGICAL PLANNING & RESEARCH

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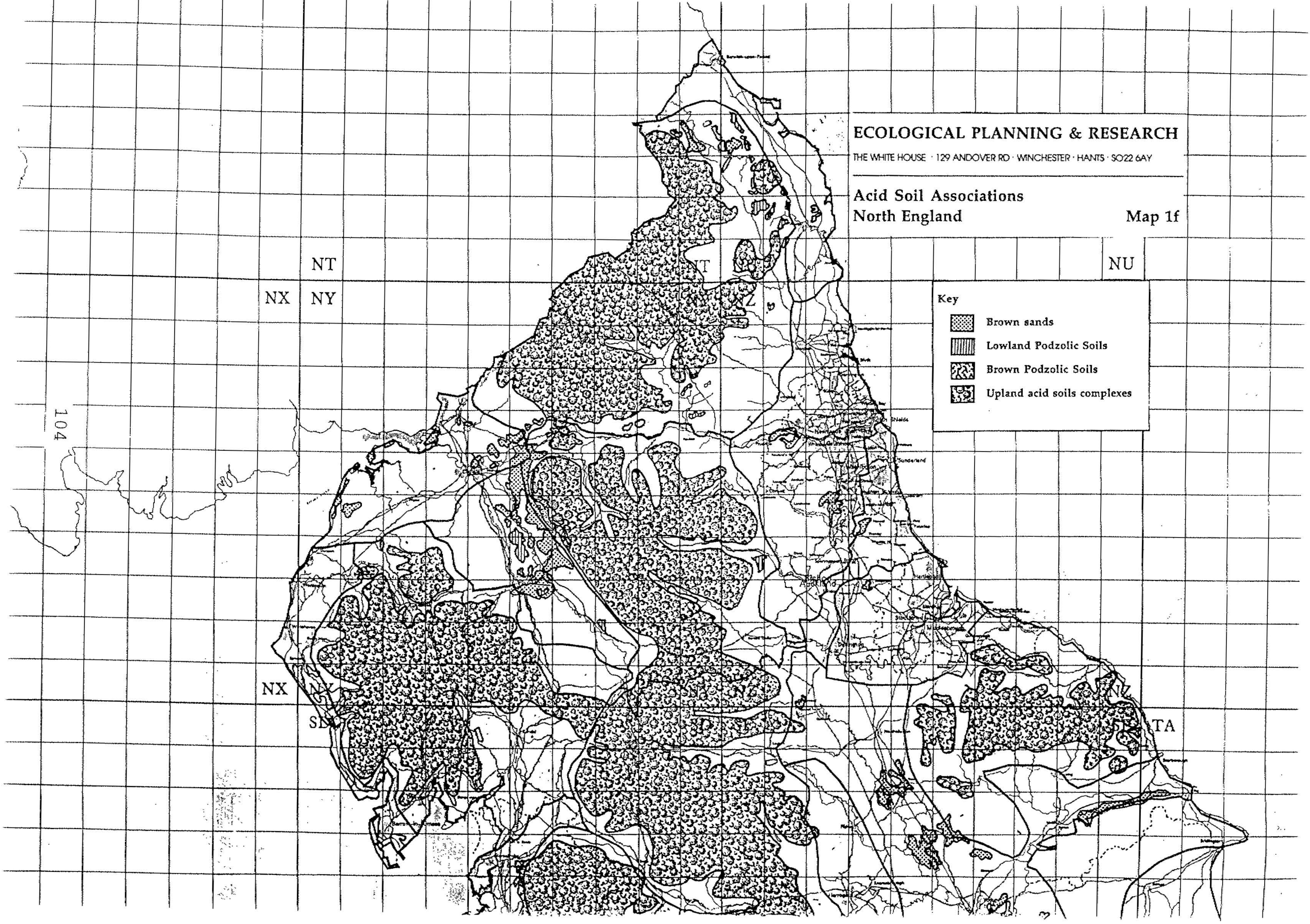
Acid Soil Associations
Mid to North England

Map 1e

Key

▒	Brown sands
▥	Lowland Podzolic Soils
▨	Brown Podzolic Soils
▩	Upland acid soils complexes



ECOLOGICAL PLANNING & RESEARCH

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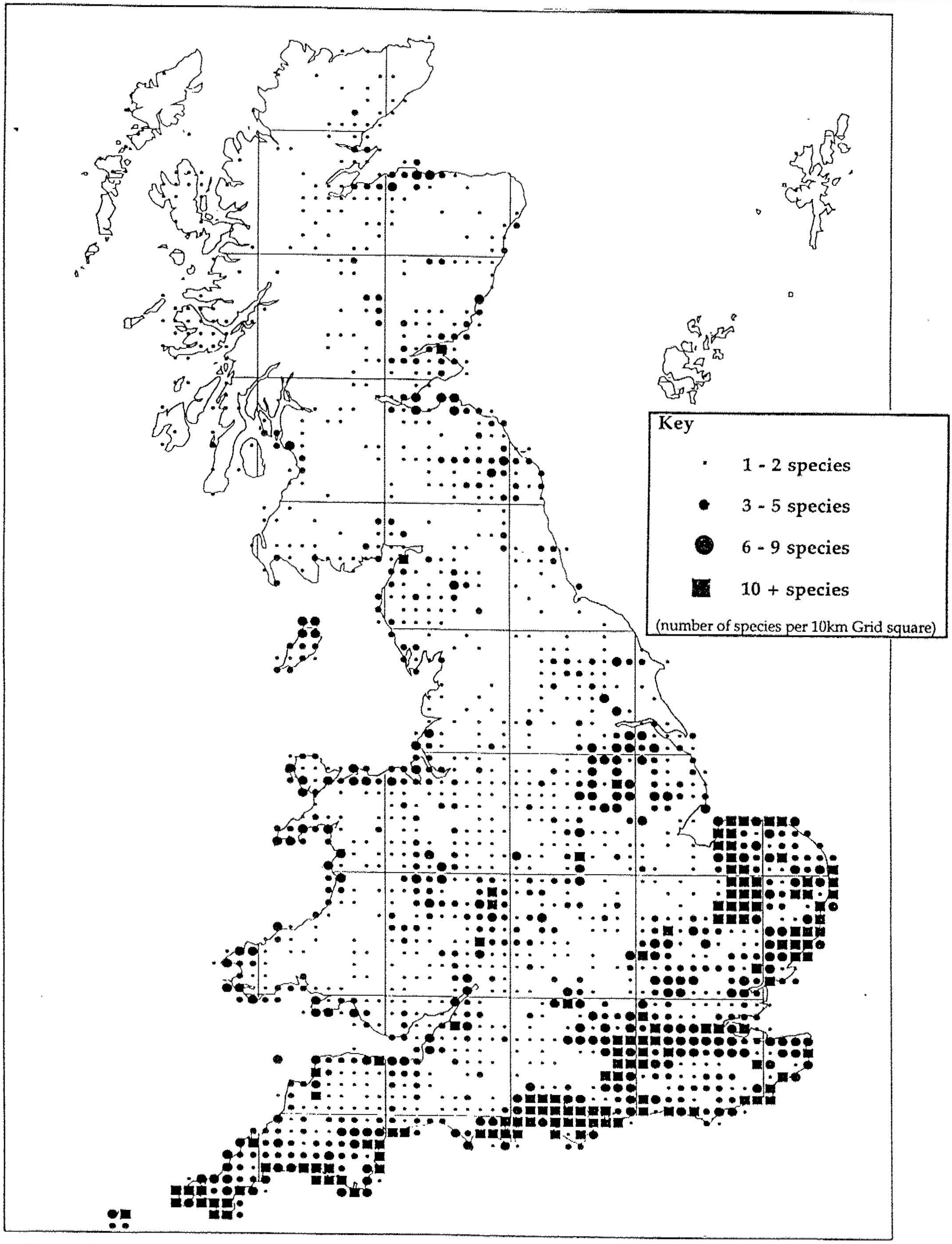
Acid Soil Associations
North England
Map 1f

Key
▨ Brown sands
▥ Lowland Podzolic Soils
▨ Brown Podzolic Soils
▨ Upland acid soils complexes
NT
NX
NY
NU
NT
NY
NZ
NX
NY
SD
SE
NZ
TA
Sunderland
Barrow-in-Furness

Lowland acid grassland plant species from Table 1: all records for 33 species. Map 2


Key
· 1 - 2 species
• 3 - 5 species
● 6 - 9 species
■ 10 + species
(number of species per 10km Grid square)

Data supplied by the Biological Records Centre, Monks Wood

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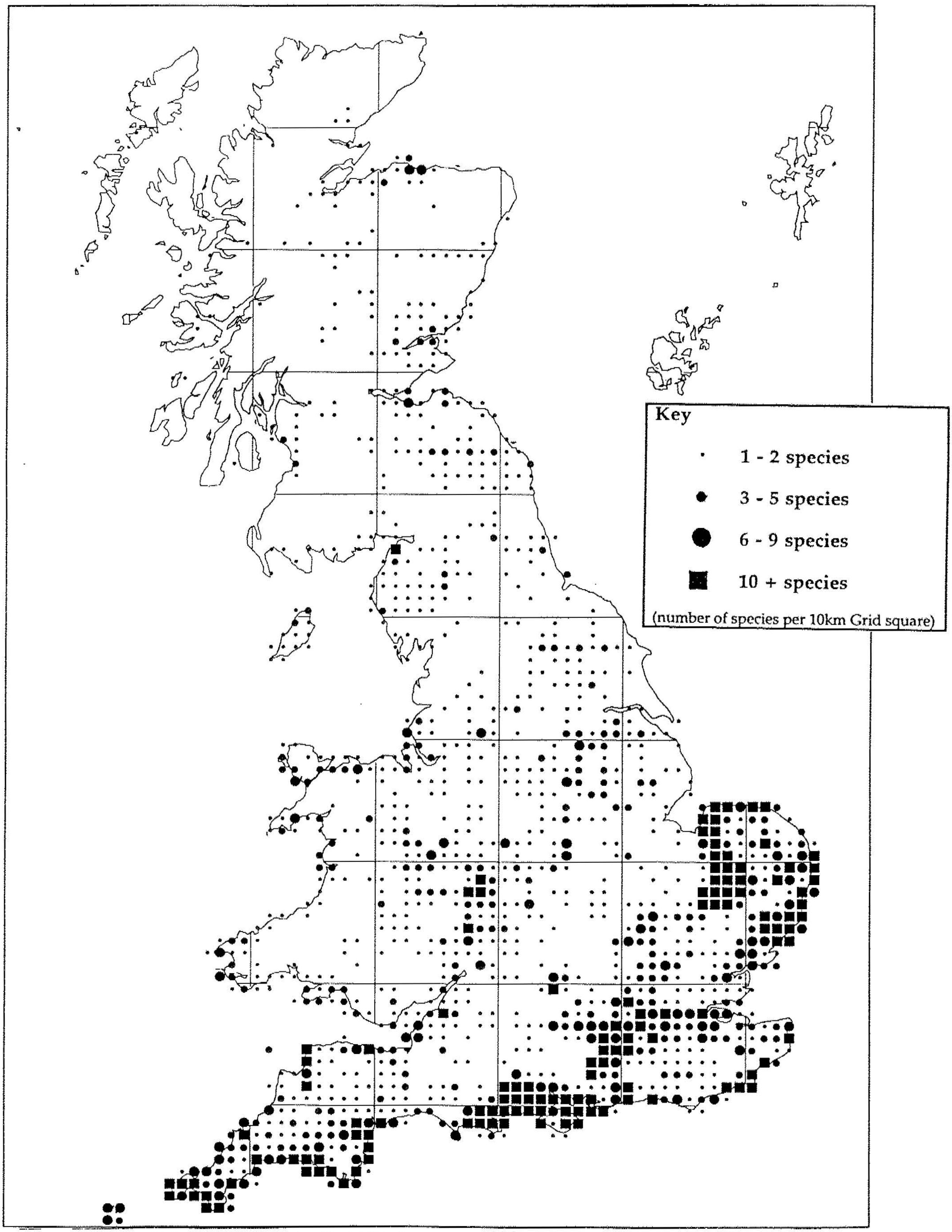
Lowland acid grassland plant species from Table 1: all records for 25 updated species. Map 3


Key
1 - 2 species
3 - 5 species
6 - 9 species
10 + species
(number of species per 10km Grid square)

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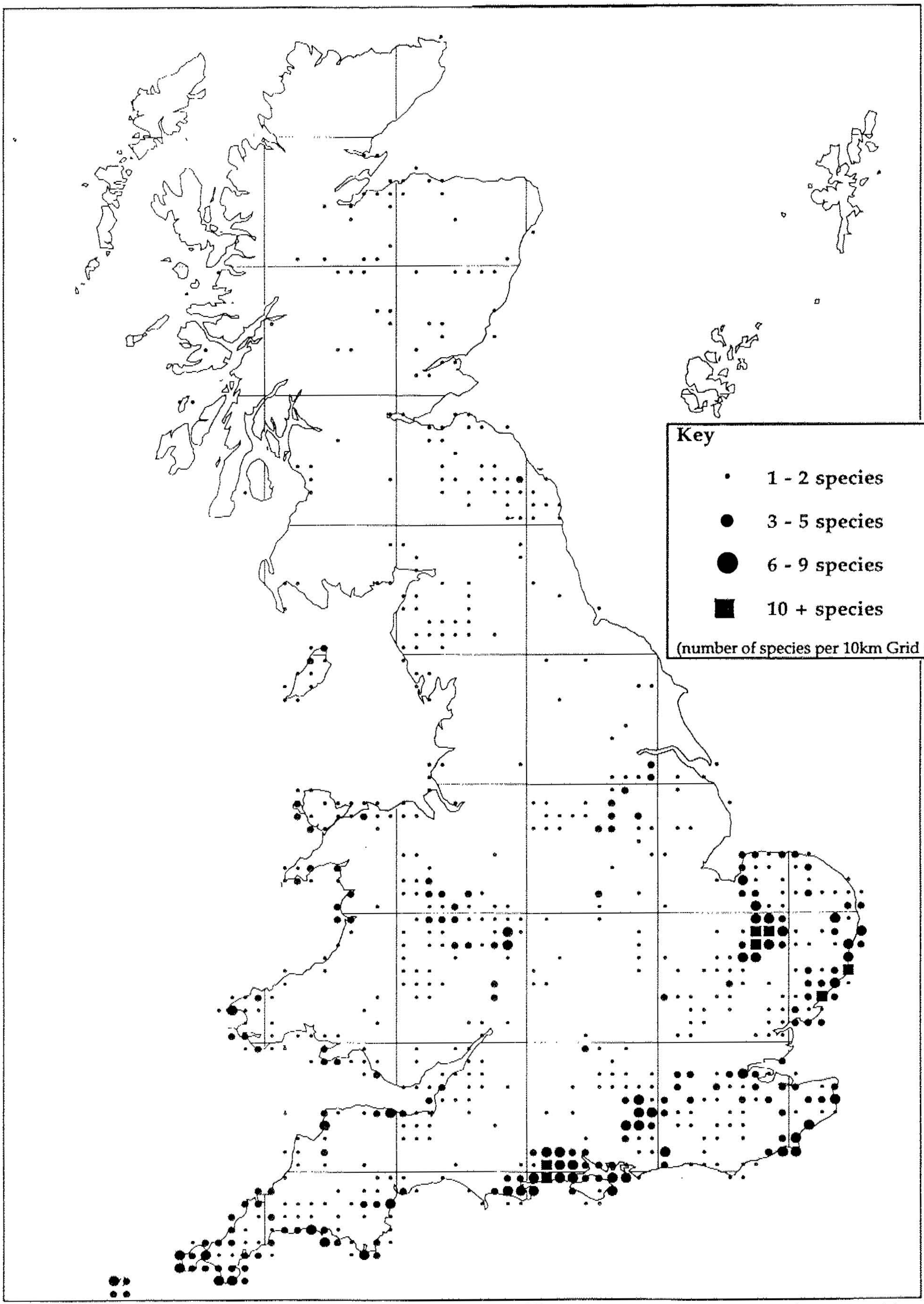
Lowland acid grassland plant species from Table 1: post-1970 records for 25 updated species. Map 4


Key
• 1 - 2 species
● 3 - 5 species
⬤ 6 - 9 species
■ 10 + species
(number of species per 10km Grid square)

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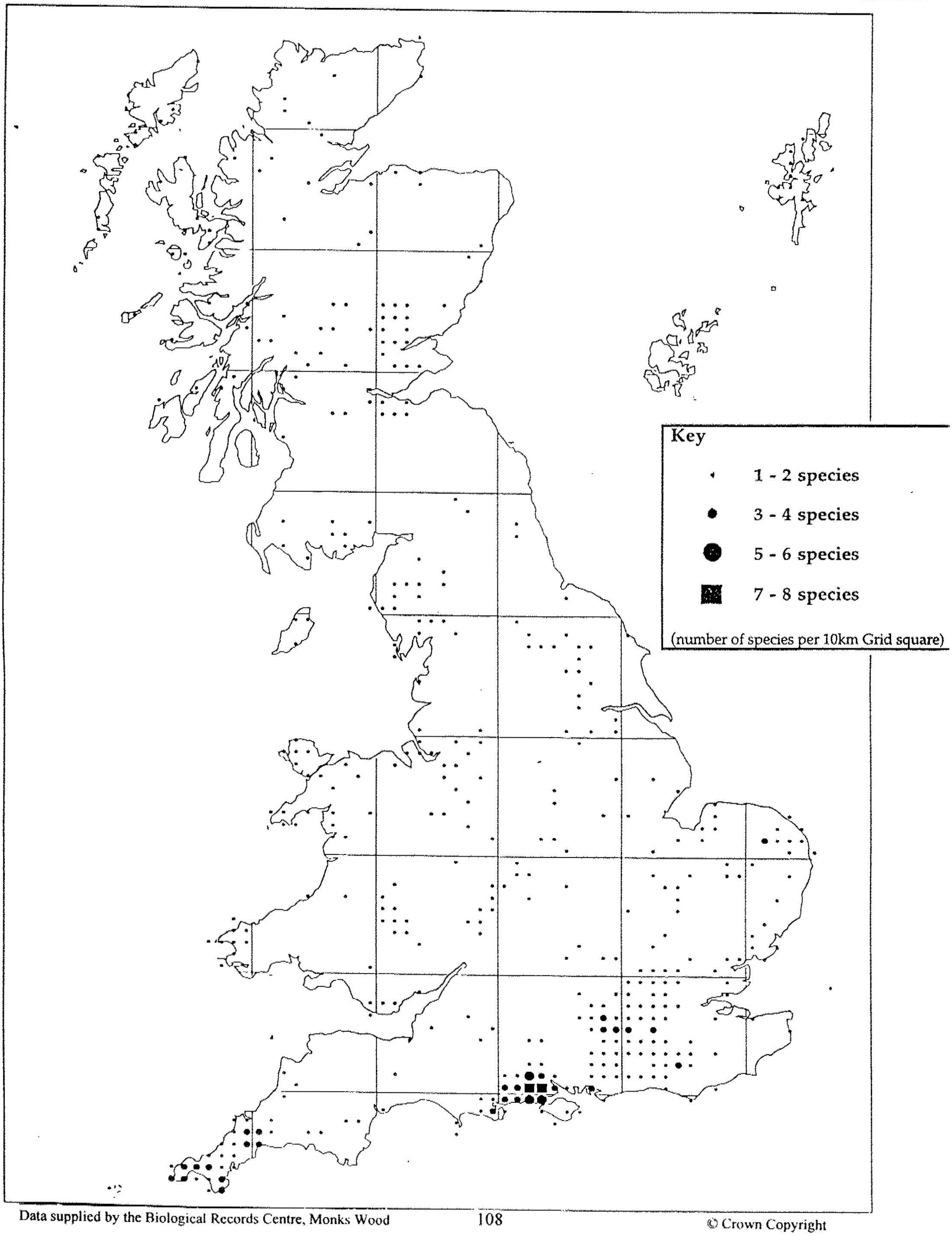
Lowland acid grassland Ephemeral pond species - all records

Map 5


Key
· 1 - 2 species
• 3 - 4 species
● 5 - 6 species
■ 7 - 8 species
(number of species per 10km Grid square)

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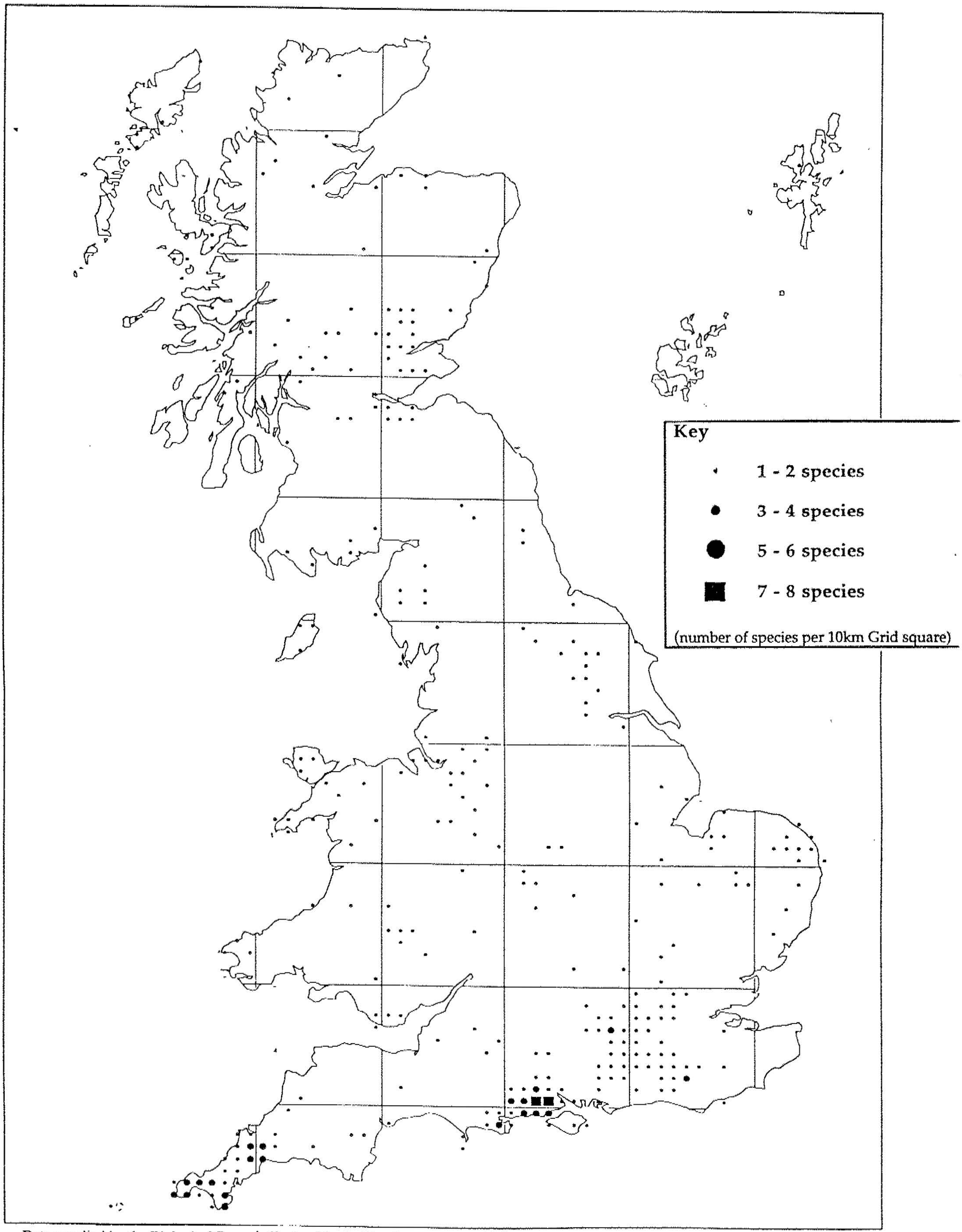
Lowland acid grassland
Ephemeral pond species - pre 1970 Map 6



Key
· 1 - 2 species
• 3 - 4 species
● 5 - 6 species
■ 7 - 8 species
(number of species per 10km Grid square)

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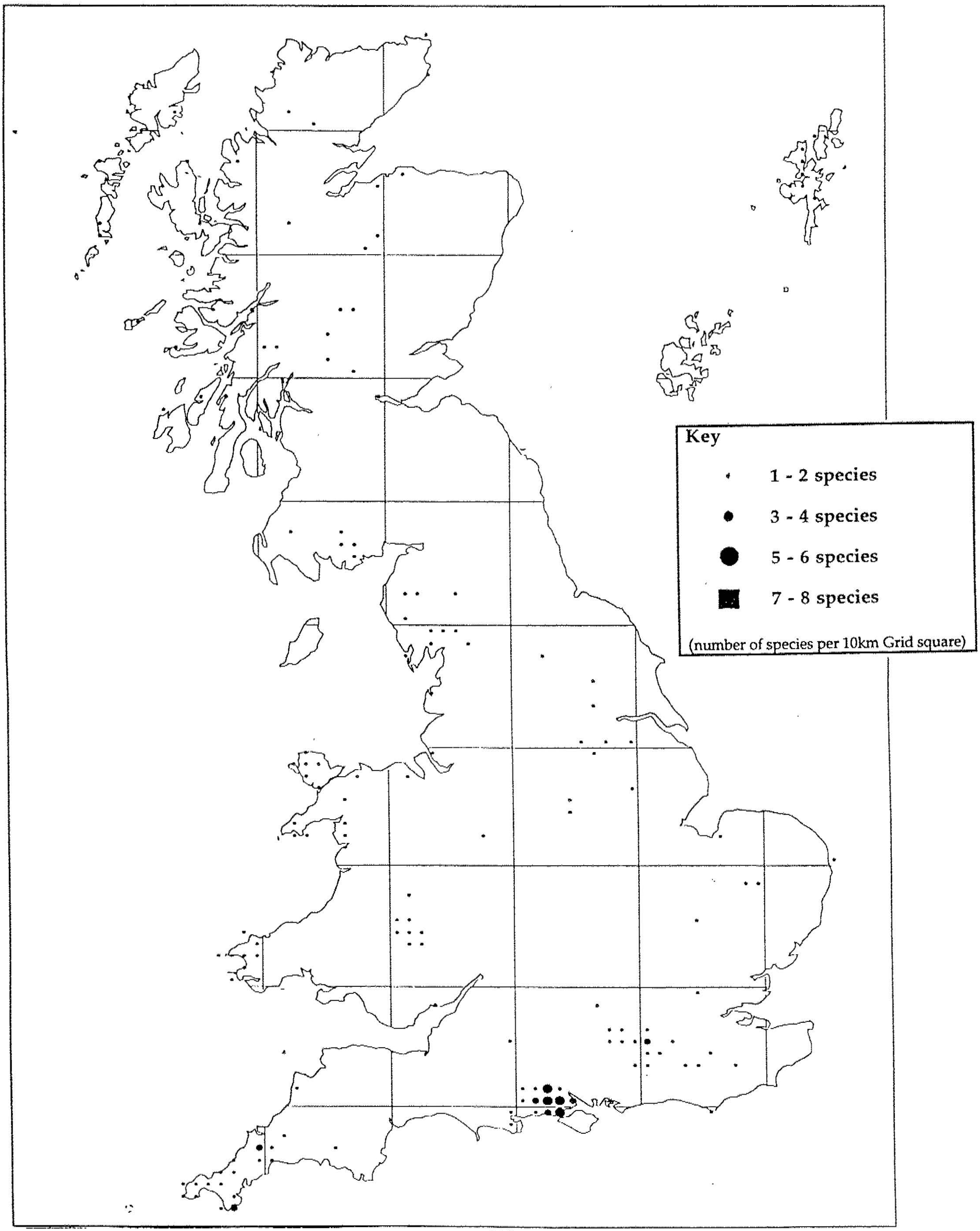
Lowland acid grassland
Ephemeral pond species - post 1970 Map 7


Key
1 - 2 species
3 - 4 species
5 - 6 species
7 - 8 species
(number of species per 10km Grid square)

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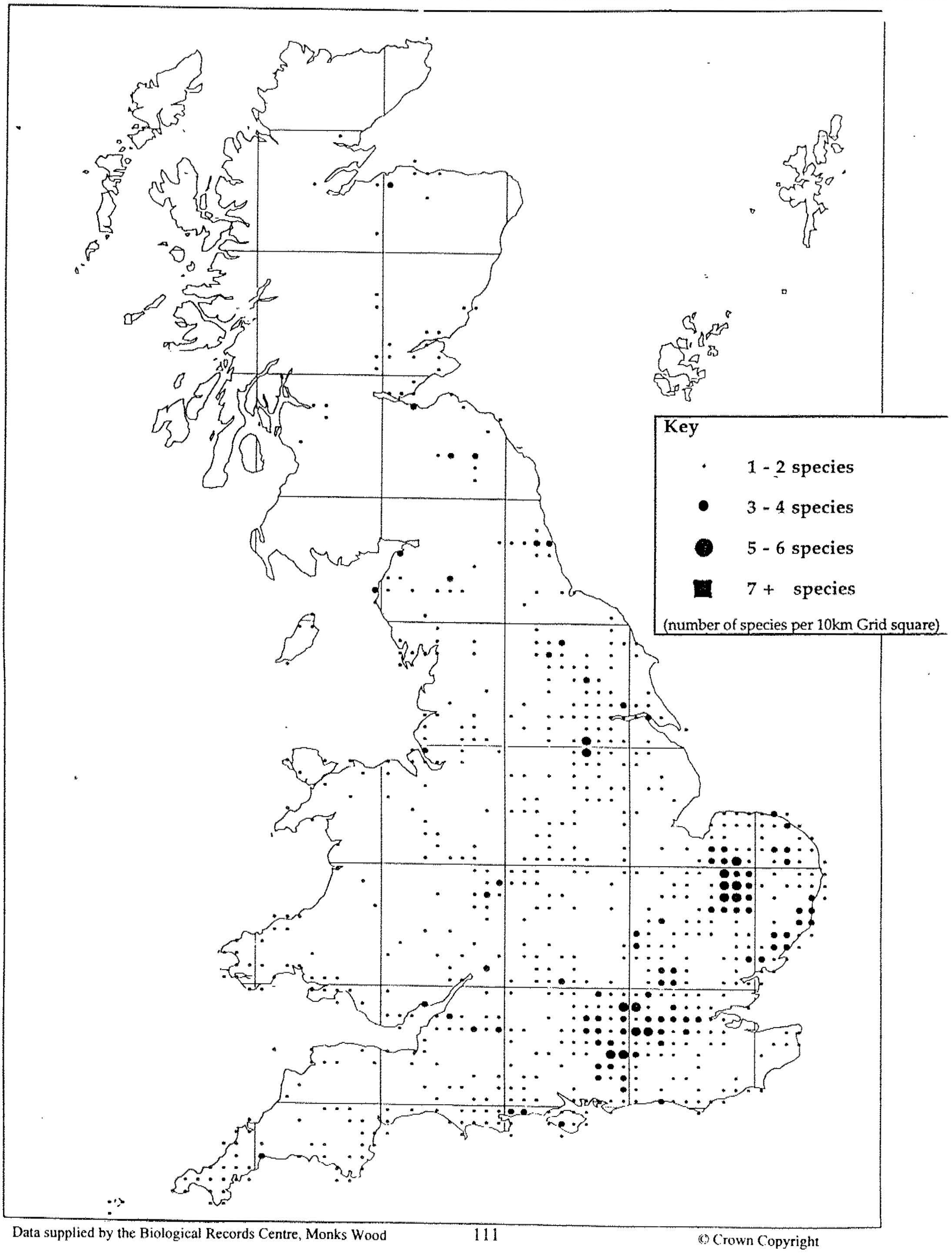
Lowland acid grassland
Disturbed sandy soil species: all records. Map 8


Key
1 - 2 species
3 - 4 species
5 - 6 species
7 + species
(number of species per 10km Grid square)

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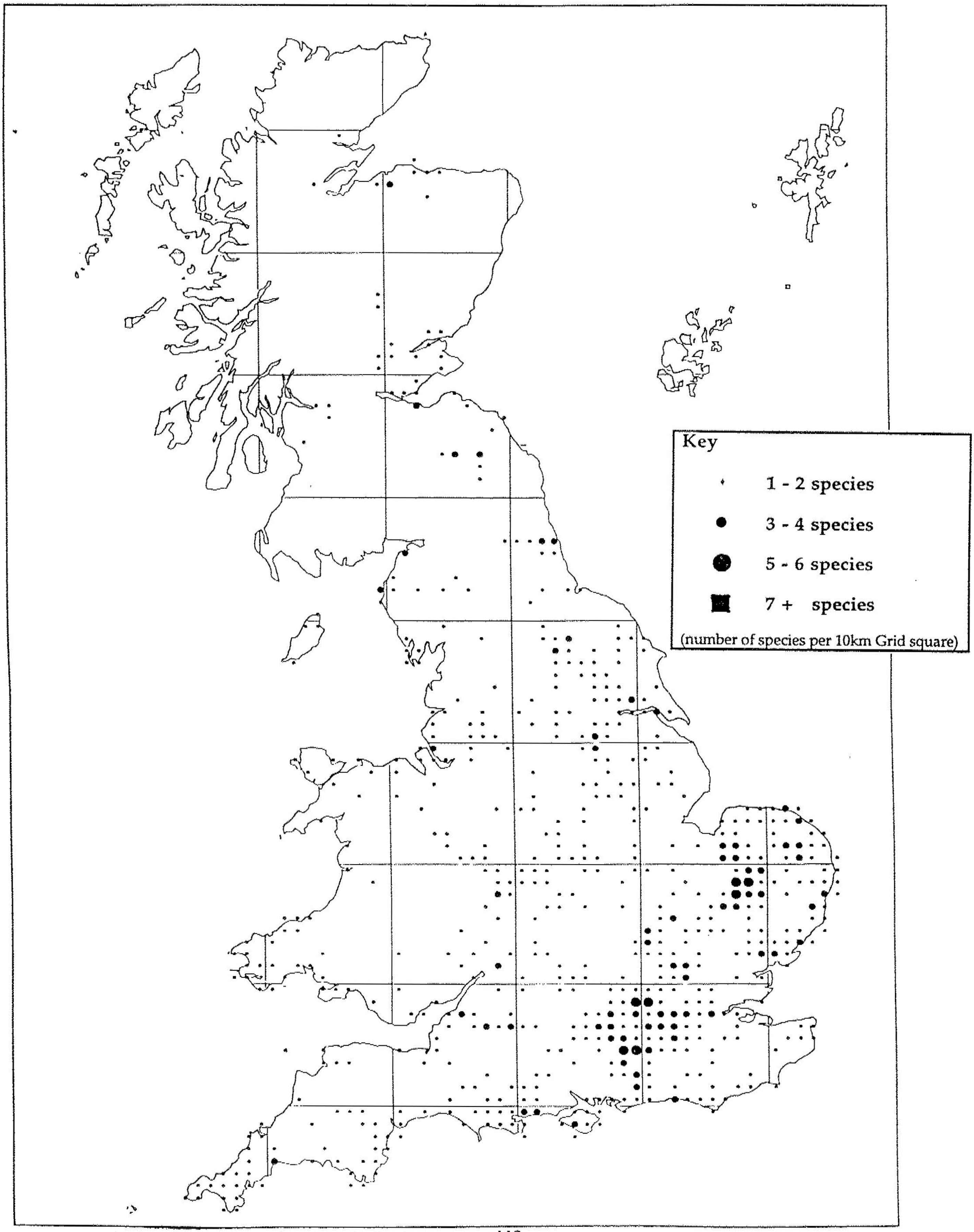
Lowland acid grassland Map 9
Disturbed sandy soil species: pre-1970 records


Key
• 1 - 2 species
● 3 - 4 species
⬤ 5 - 6 species
■ 7 + species
(number of species per 10km Grid square)

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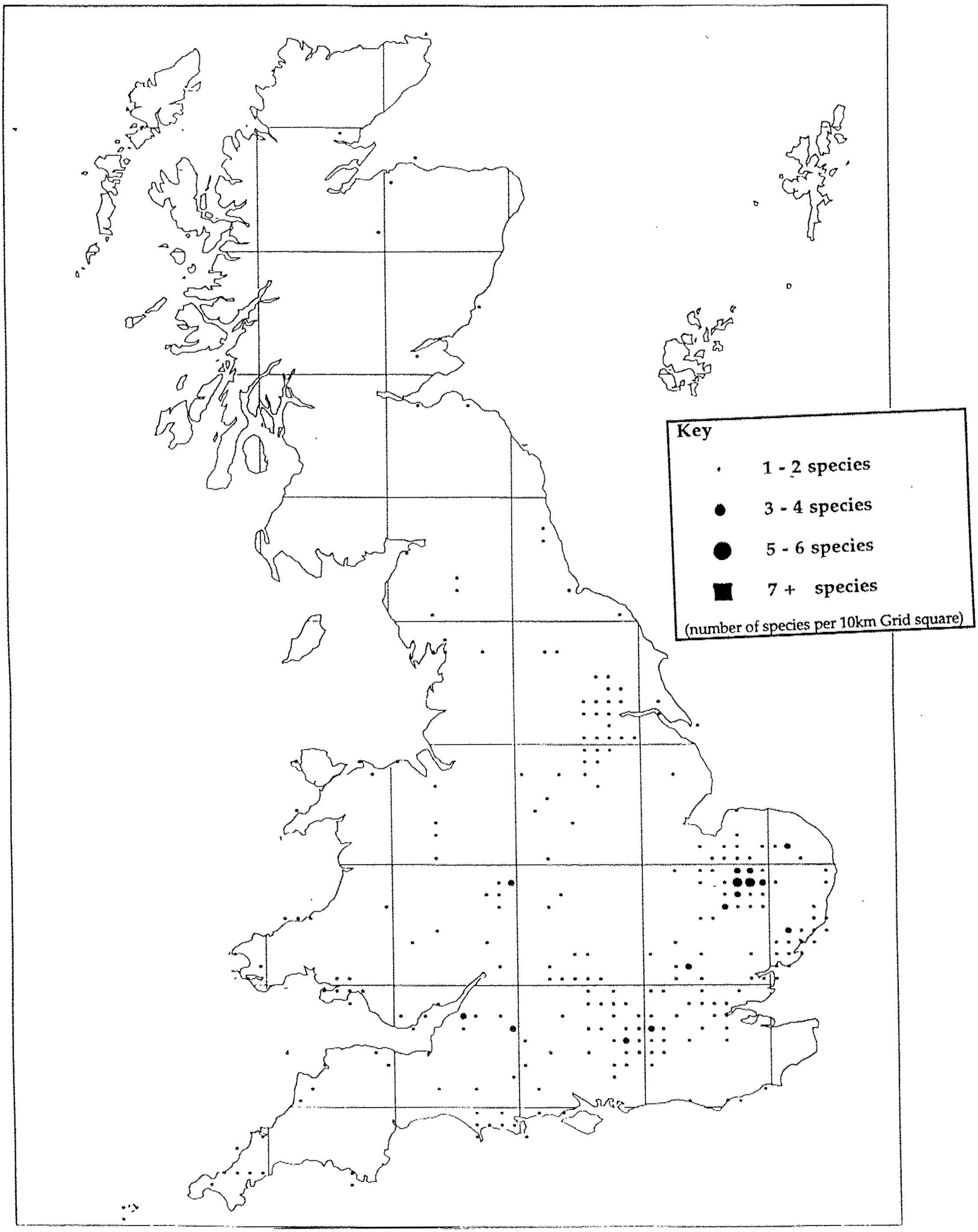
Lowland acid grassland
Disturbed sandy soil species: post-1970 records. Map 10


Key
1 - 2 species
3 - 4 species
5 - 6 species
7 + species
(number of species per 10km Grid square)

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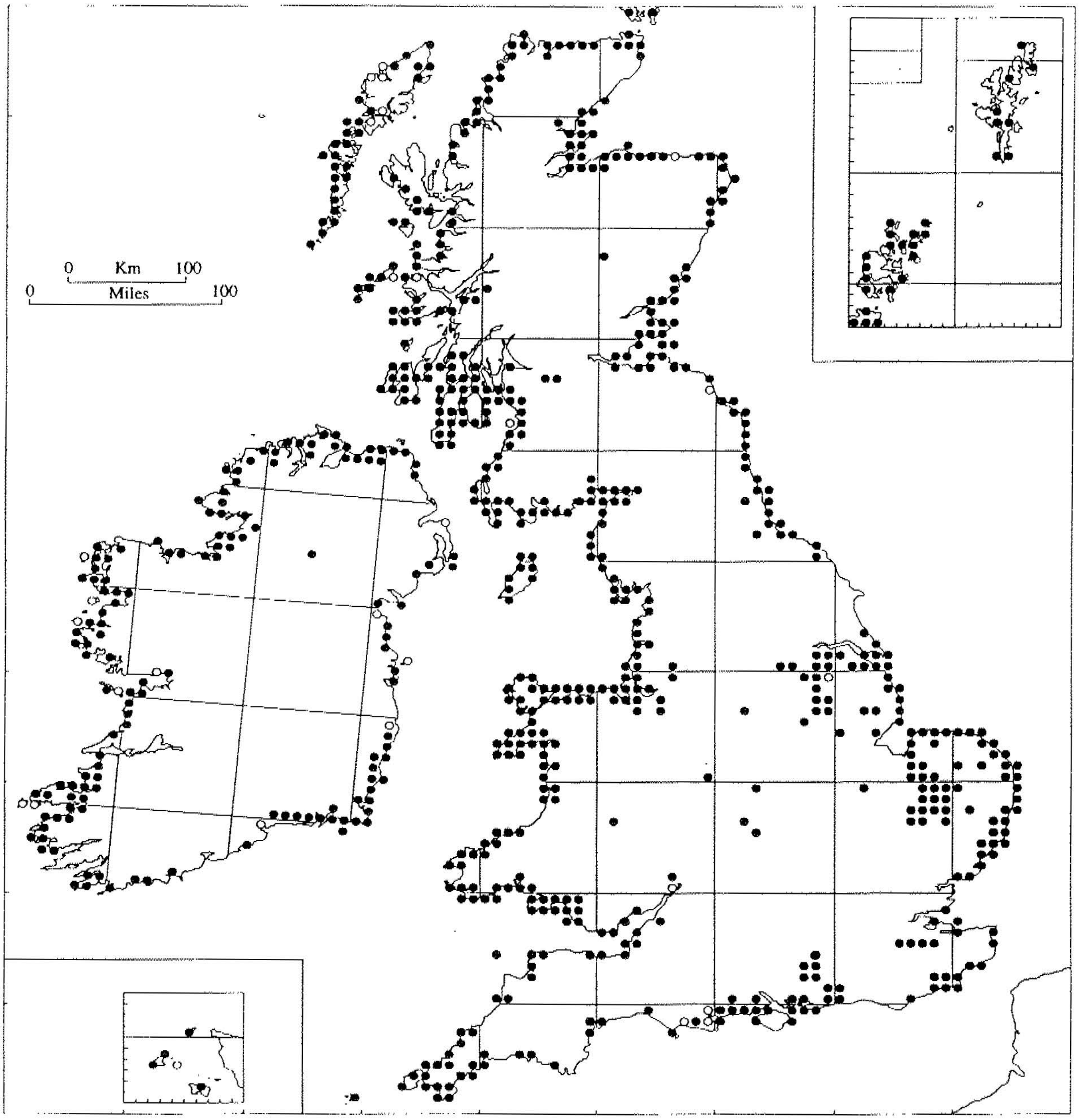
Carex arenaria

A species of inland sand dunes Map 11



● 1950 onwards (GB - 587, Ir - 137, Ch.Is. - 4)

○ before 1950 (GB - 15, Ir - 12, Ch.Is. - 1)

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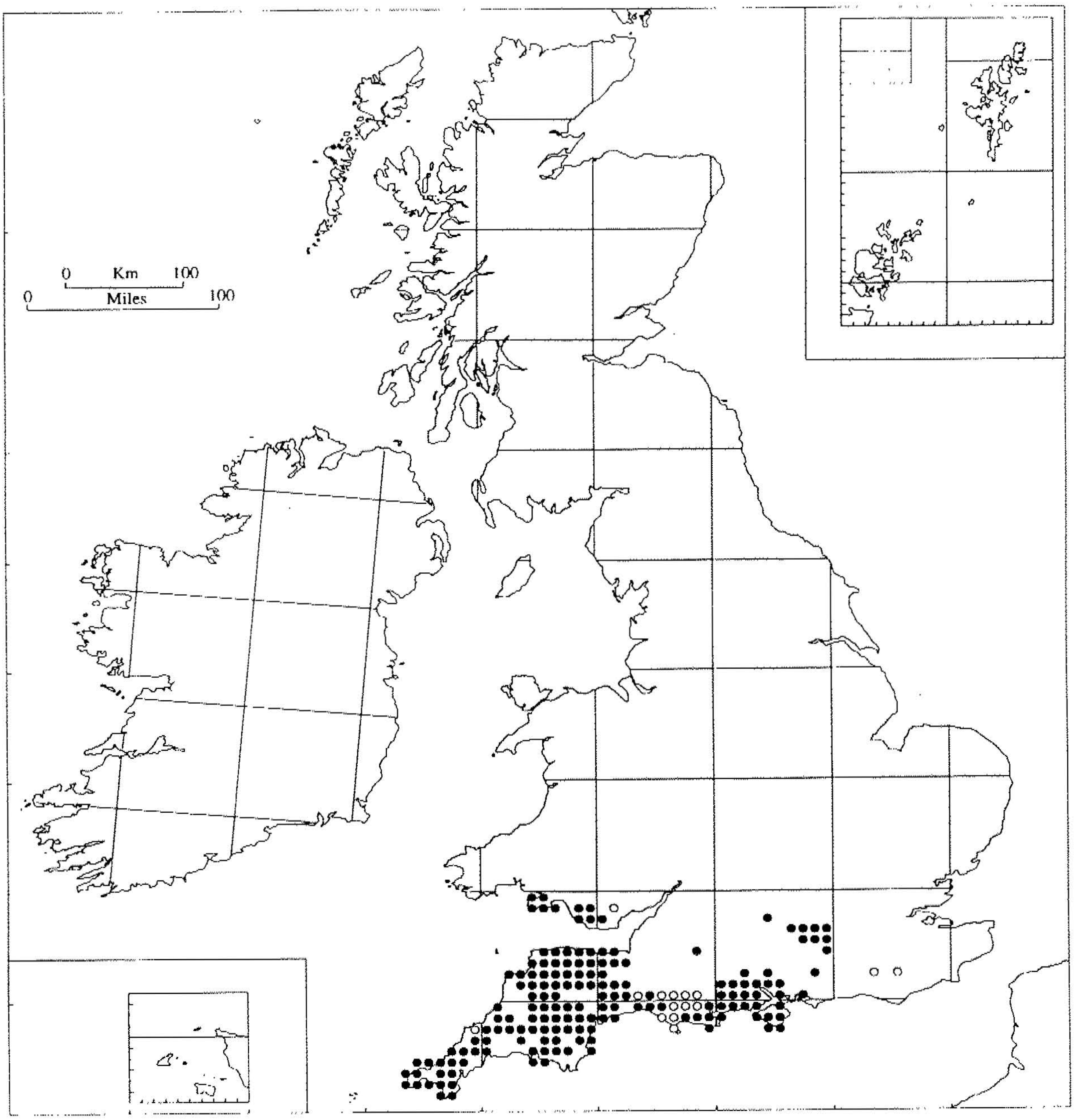
Agrostis curtisii

Indicates the potential range of U3 Map 12



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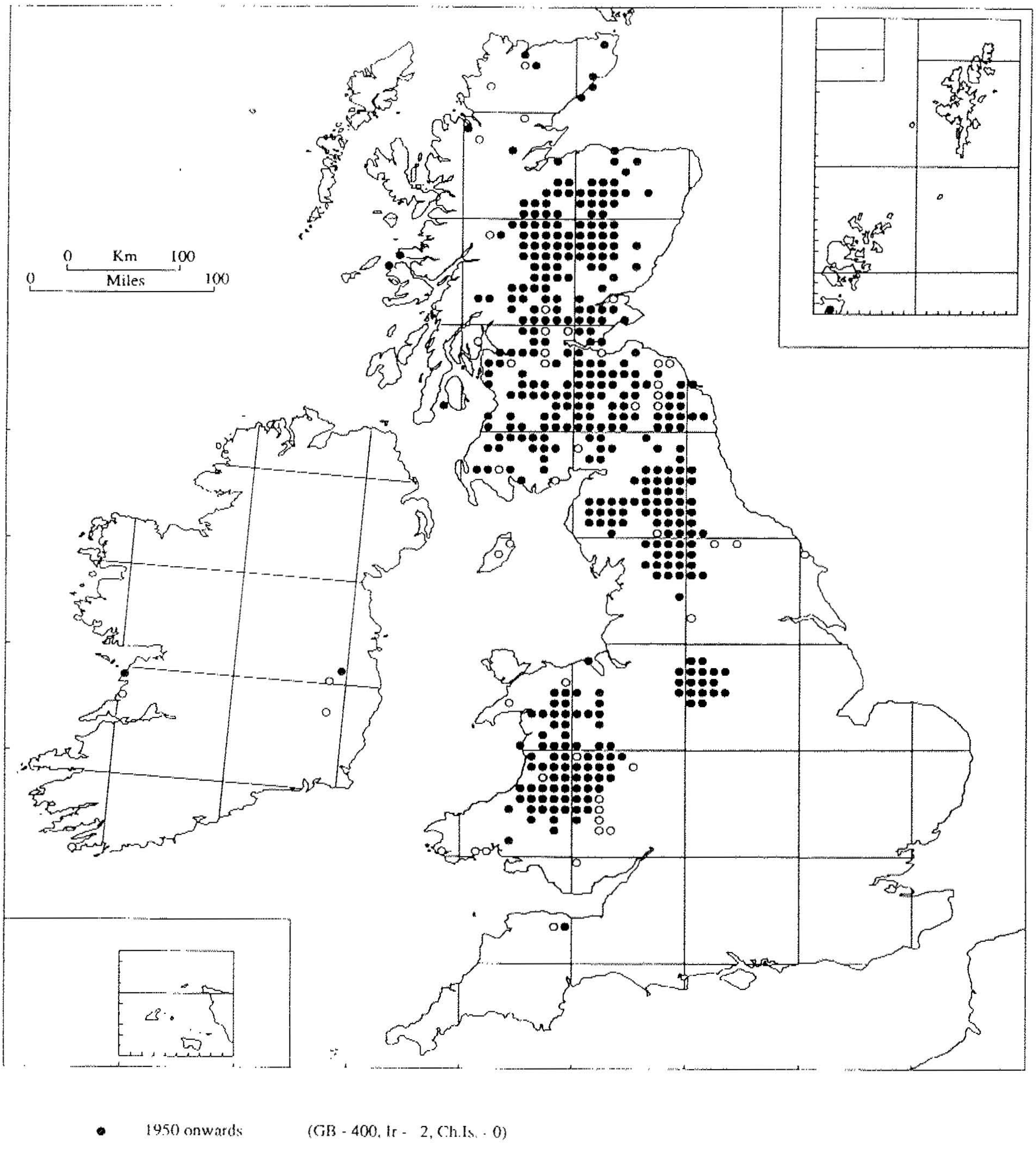
Viola lutea

A characteristic upland species Map 13



● 1950 onwards (GB - 400, Ir - 2, Ch.Is. - 0)

○ before 1950 (GB - 45, Ir - 4, Ch.Is. - 0)

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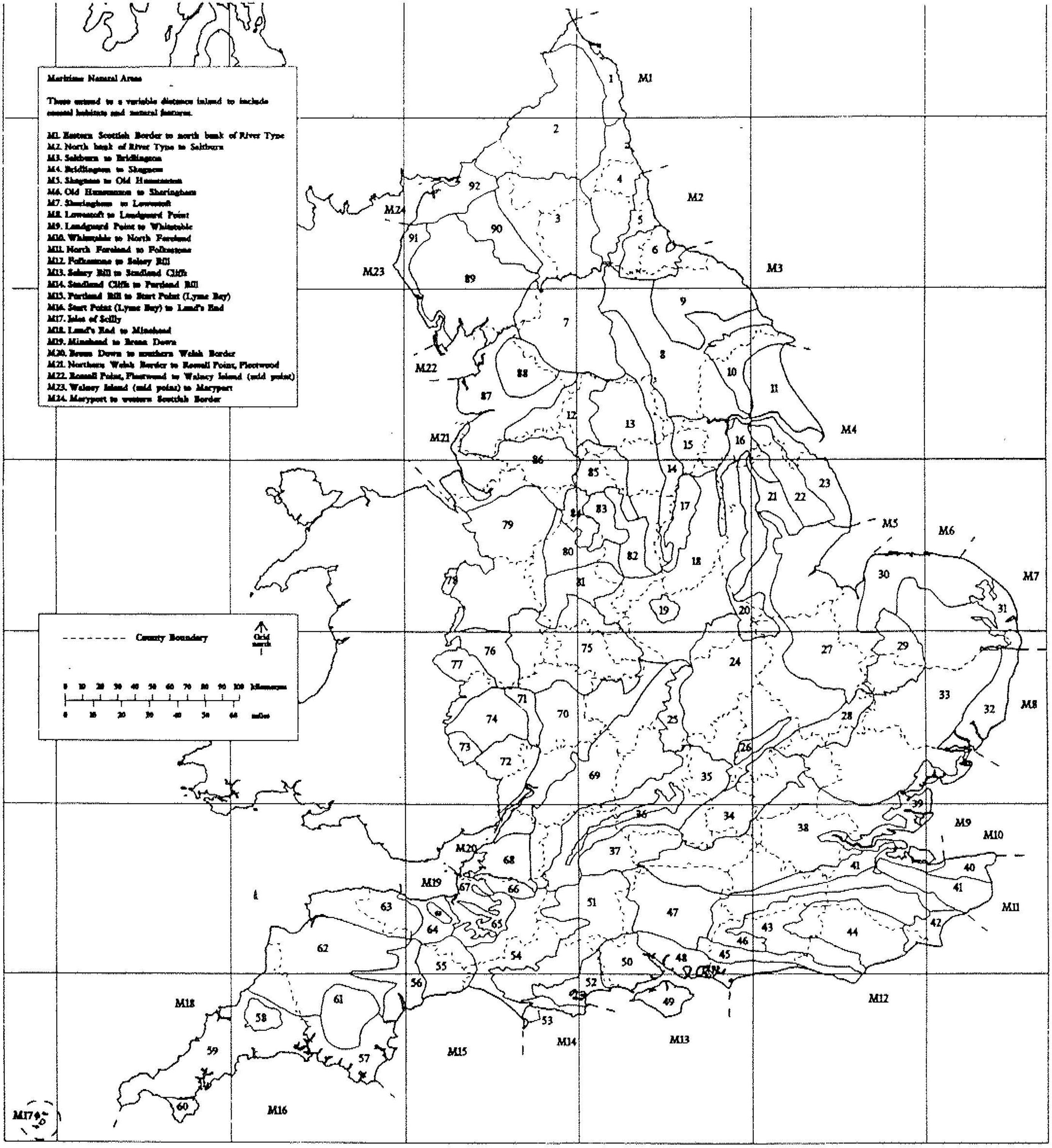
Old Natural Area boundaries as used for Maps 1a-f. Map 14


Maritime Natural Areas
These extend to a variable distance inland to include coastal habitats and natural features.
M1. Eastern Scottish Border to north bank of River Tyne
M2. North bank of River Tyne to Saltburn
M3. Saltburn to Bridlington
M4. Bridlington to Skegness
M5. Skegness to Old Hunstanton
M6. Old Hunstanton to Sheringham
M7. Sheringham to Lowestoft
M8. Lowestoft to Landguard Point
M9. Landguard Point to Whitstable
M10. Whitstable to North Foreland
M11. North Foreland to Folkestone
M12. Folkestone to Selsey Bill
M13. Selsey Bill to Studland Cliffs
M14. Studland Cliffs to Portland Bill
M15. Portland Bill to Start Point (Lyme Bay)
M16. Start Point (Lyme Bay) to Land's End
M17. Isles of Scilly
M18. Land's End to Minehead
M19. Minehead to Brean Down
M20. Brean Down to southern Welsh Border
M21. Northern Welsh Border to Rossall Point, Fleetwood
M22. Rossall Point, Fleetwood to Walney Island (mid point)
M23. Walney Island (mid point) to Maryport
M24. Maryport to western Scottish Border
County Boundary
Grid north
0 10 20 30 40 50 60 70 80 90 100 kilometres
0 10 20 30 40 50 60 miles

1. Northumberland Coastal Plain
2. Border Uplands
3. North Pennines
4. Northumbrian Coal Measures
5. Durham Magnesian Limestone
6. Lower Tees
7. Yorkshire Dales
8. The Vales of Yorkshire
9. North York Moors
10. Yorkshire Wolds
11. Plain of Holderness
12. Southern Pennines
13. Coal Measures
14. Southern Magnesian Limestone
15. Humberhead Levels
16. Coversands
17. Sherwood Forest
18. Trent Valley and Levels
19. Charnwood Forest
20. Lincolnshire Limestone
21. Lincolnshire Clay Vales
22. Lincolnshire Wolds
23. Lincolnshire Marsh and Coast
24. Middle England
25. Northamptonshire Uplands
26. Bedfordshire Greensand
27. Fenland
28. East Anglian Southern Chalk
29. Breckland
30. North Norfolk
31. Broadland
32. Suffolk Coast and Heaths
33. East Anglian Plain
34. Chilterns
35. Oxford Clay Vales
36. Oxford Heights
37. Wessex Downs
38. London Basin
39. Thames Marshes
40. North Kent Plain
41. North Downs
42. Romney Marsh
43. Low Weald
44. High Weald
45. South Downs
46. Greensand
47. Hampshire Chalk
48. South Coast Plain
49. Isle of Wight
50. New Forest
51. South Wessex Downs
52. Dorset Heaths
53. Isles of Portland and Purbeck
54. Wessex Vales
55. Blackdowns
56. Devon Redland
57. South Devon
58. Bodmin Moor
59. Cornish Killas and Granite
60. The Lizard
61. Dartmoor
62. Culm Measures
63. Exmoor and the Quantocks
64. Vale of Taunton
65. Mid Somerset Hills
66. Mendips
67. Somerset Levels and Moors
68. Avon Ridges and Valleys
69. Greater Cotswolds
70. Severn Valley
71. Malvern Hills and Teme Valley
72. Dean Plateau and Wye Valley
73. Black Mountains and Golden Valley
74. Hereford Plain
75. Midlands Plateau
76. Shropshire Hills
77. Central Marches
78. Oswestry Uplands
79. Mosses and Meres
80. Staffordshire Uplands
81. Upper Trent Valley
82. The Derwent Valley
83. White Peak
84. South West Peak
85. Dark Peak
86. Urban Mersey Basin
87. Lancashire Plain and Valleys
88. Forest of Bowland
89. Cumbrian Fells and Dales
90. Eden Valley
91. West Cumbria Coastal Plain
92. Solway Basin

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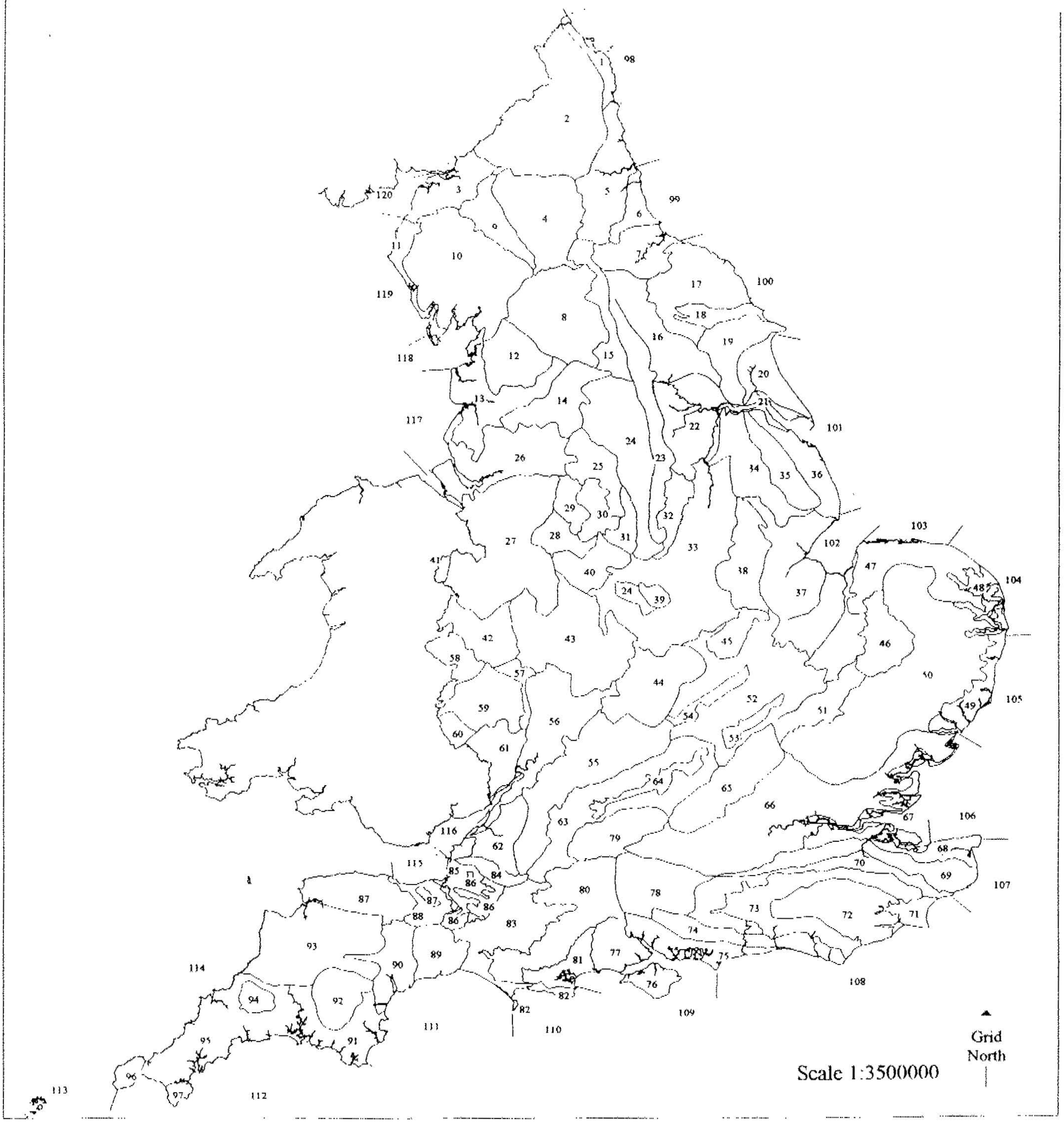
New Natural Area boundaries. Map 15



1 North Northumberland Coastal Plain
2. Border Uplands
3 Solway Basin
4. North Pennines
5. Northumbria Coal Measures
6. Durham Magnesian Limestone Plateau
7 Tees Lowlands
8 Yorkshire Dales
9 Eden Valley
10 Cumbria Fells and Dales

11 West Cumbria Coastal Plain
12 Forest of Bowland
13 Lancashire Plain and Valleys
14 Southern Pennines
15 Pennine Dales Fringe
16. Vale of York and Mowbray
17 North York Moors and Hills
18. Vale of Pickering
19 Yorkshire Wolds
20 Holderness

21 Humber Estuary
22. Humberhead Levels
23 Southern Magnesian Limestone
24 Coal Measures
25 Dark Peak
26 Urban Mersey Basin
27 Mosses and Meres
28 Potteries and Churnet Valley
29 South West Peak
30 White Peak

31. Derbyshire Peak Fringe and Lower Derwent
32. Sherwood
33 Trent Valley and Rises
34 North Lincolnshire Coversands and Clay Vales
35 Lincolnshire Wolds
36 Lincolnshire Coast and Marshes
37 The Fens
38 Lincolnshire and Rutland Limestone
39 Charnwood
40 Needwood and South Derbyshire Claylands

41 Oswestry Uplands
42 Shropshire Hills
43 Midlands Plateau
44 Midland Clay Pastures
45 Rockingham Forest
46 Breckland
47 North Norfolk
48 The Broads
49 Suffolk Coast and Heaths
50 East Anglian Plain

51 East Anglian Chalk
52. West Anglian Plain
53. Bedfordshire Greensand Ridge
54. Yardley-Whittlewood Ridge
55 Cotswolds
56 Severn and Avon Vales
57 Malvern Hills and Teme Valley
58 Clun and North West Herefordshire Hills
59. Central Herefordshire
60. Black Mountains and Golden Valley

61 Dean Plateau and Wye Valley
62 Bristol, Avon Valleys and Ridges
63 Thames and Avon Vales
64 Midvale Ridge
65 Chilterns
66 London Basin
67 Greater Thames Estuary
68 North Kent Plain
69 North Downs
70 Wealden Greensand

71 Romney Marshes
72 High Weald
73 Low Weald and Pevensey
74 South Downs
75 South Coast Plain and Hampshire Lowlands
76 Isle of Wight
77 New Forest
78 Hampshire Downs
79 Berkshire and Marlborough Downs
80 South Wessex Downs

81. Dorset Heaths
82 Isles of Portland and Purbeck
83 Wessex Vales
84 Mendip Hills
85. Somerset Levels and Moors
86 Mid Somerset Hills
87. Exmoor and the Quantocks
88 Vale of Taunton and Quantock Fringes
89 Blackdowns
90 Devon Redlands

91 South Devon
92 Dartmoor
93 The Culm
94 Bodmin Moor
95 Cornish Killas and Granites
96 West Penwith
97 The Lizard
98 Northumberland Coast
99 Tyne to Tees Coast
100 Saltburn to Bridlington

101 Bridlington to Skegness
102 The Wash
103 Old Hunstanton to Sheringham
104 Sheringham to Lowestoft
105 Suffolk Coast
106 North Kent Coast
107 East Kent Coast
108 Folkestone to Selsey Hill
109 Solent and Poole Bay
110 South Dorset Coast

111 Lyme Bay
112. Start Point to Land's End
113. Isles of Scilly
114 Land's End to Minehead
115 Bridgwater Bay
116. Severn Estuary
117 Liverpool Bay
118 Morecambe Bay
119 Cumbrian Coast
120 Solway Firth

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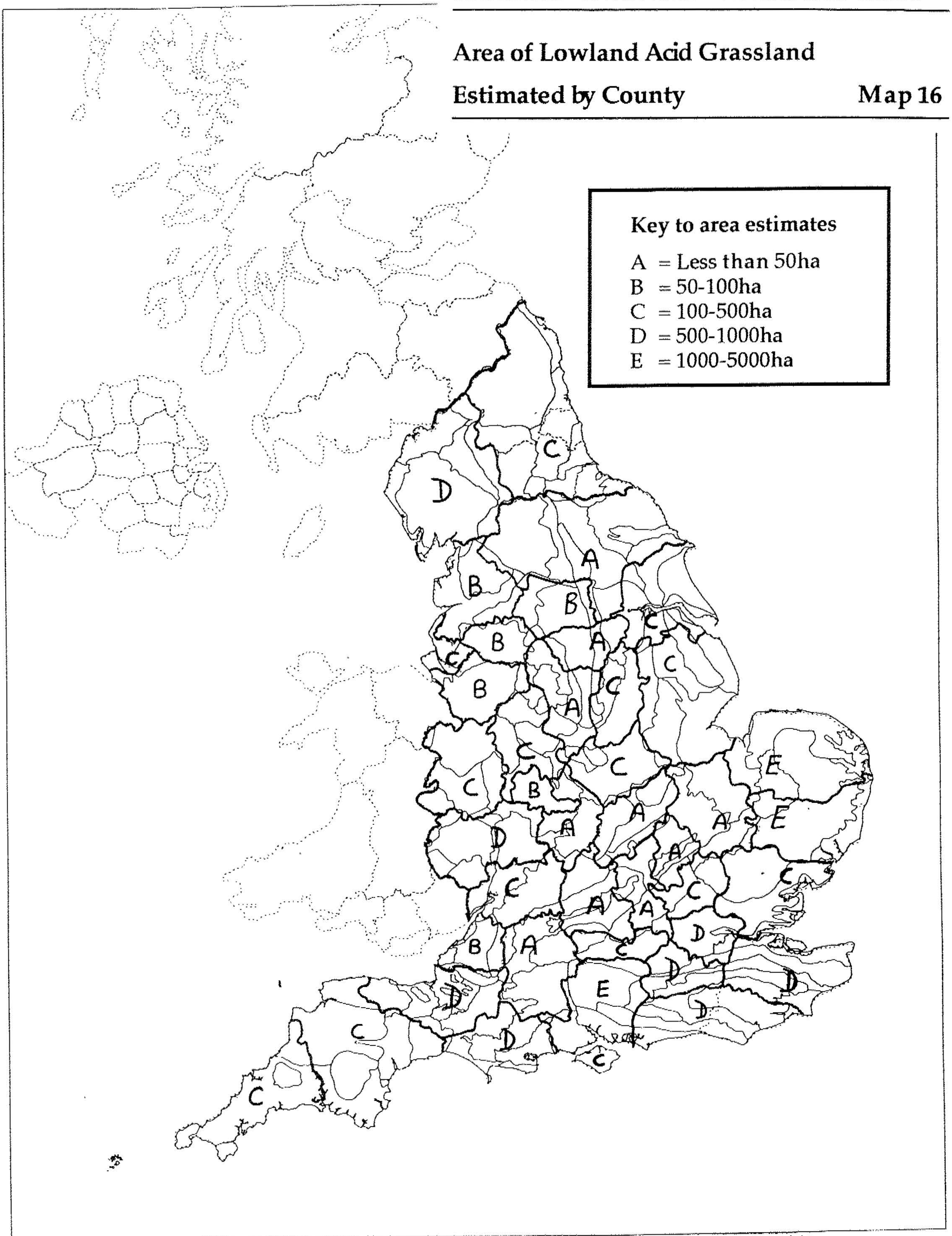
Area of Lowland Acid Grassland Estimated by County

Map 16


Key to area estimates
A = Less than 50ha
B = 50-100ha
C = 100-500ha
D = 500-1000ha
E = 1000-5000ha
C
D
A
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B
A
C
C
B
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D
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C
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D
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D
C
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C

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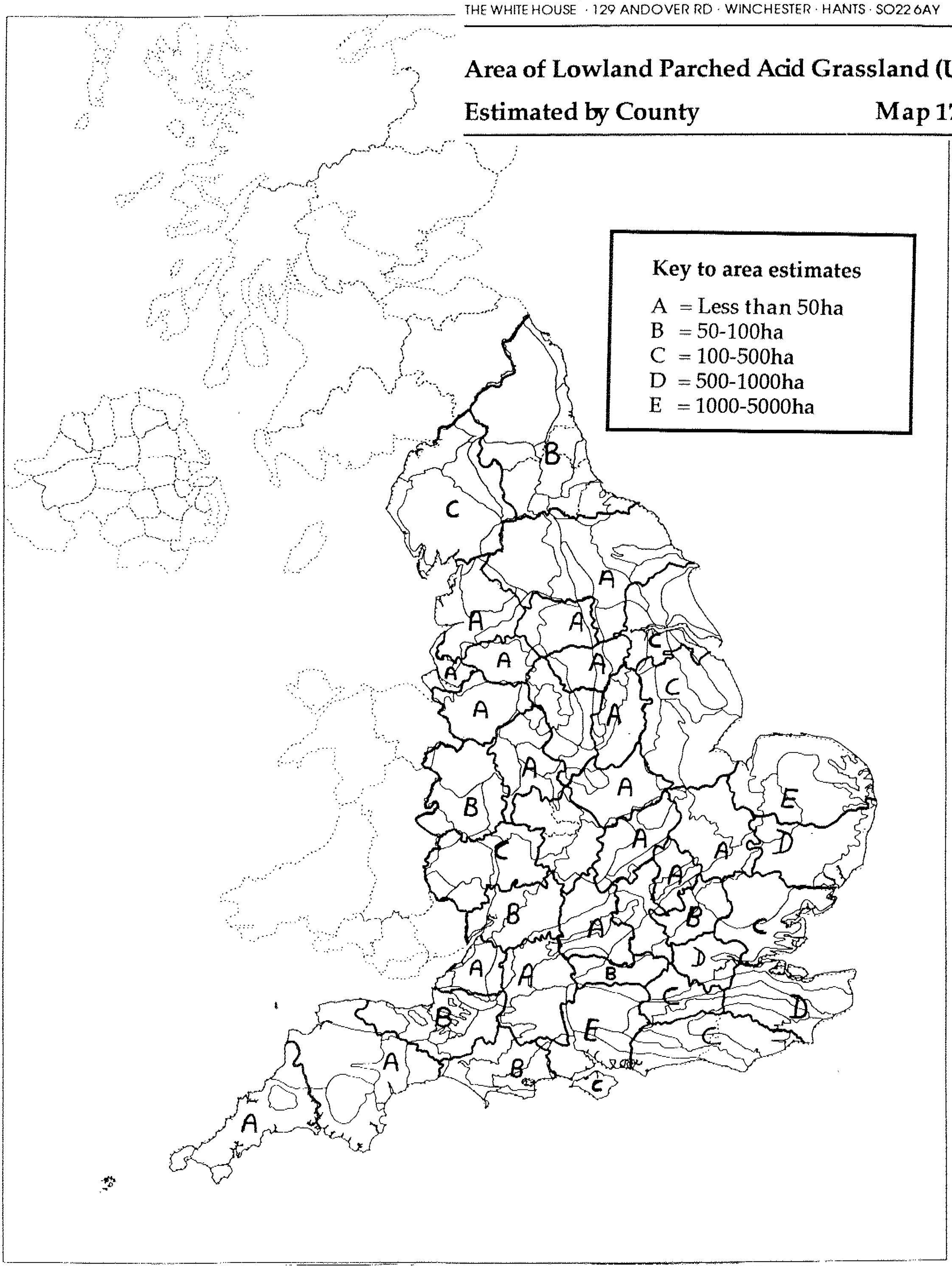
Area of Lowland Parched Acid Grassland (U1)
Estimated by County Map 17


B
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A
A
B
B
C
A
D
A
A
B
C
D
B
E
C
A
B
C
A

Key to area estimates

A = Less than 50ha
B = 50-100ha
C = 100-500ha
D = 500-1000ha
E = 1000-5000ha

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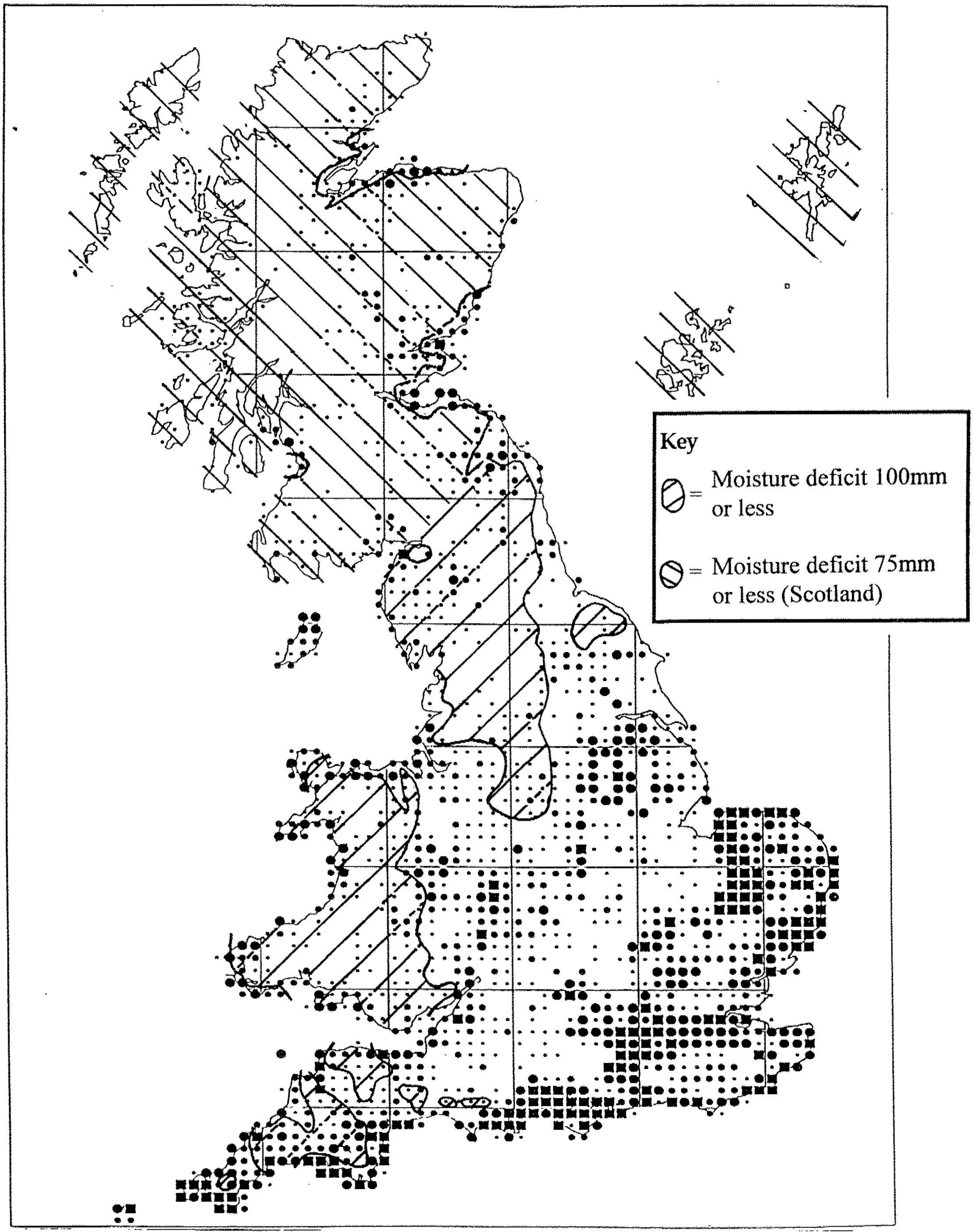
Moisture Deficit and Distribution of Lowland Acid Grassland Species Map 18

Key

- · 1 - 2 species
- • 3 - 5 species
- ● 6 - 9 species
- ■ 10 + species

(number of species per 10km grid square)


Key
▨ = Moisture deficit 100mm or less
▨ = Moisture deficit 75mm or less (Scotland)

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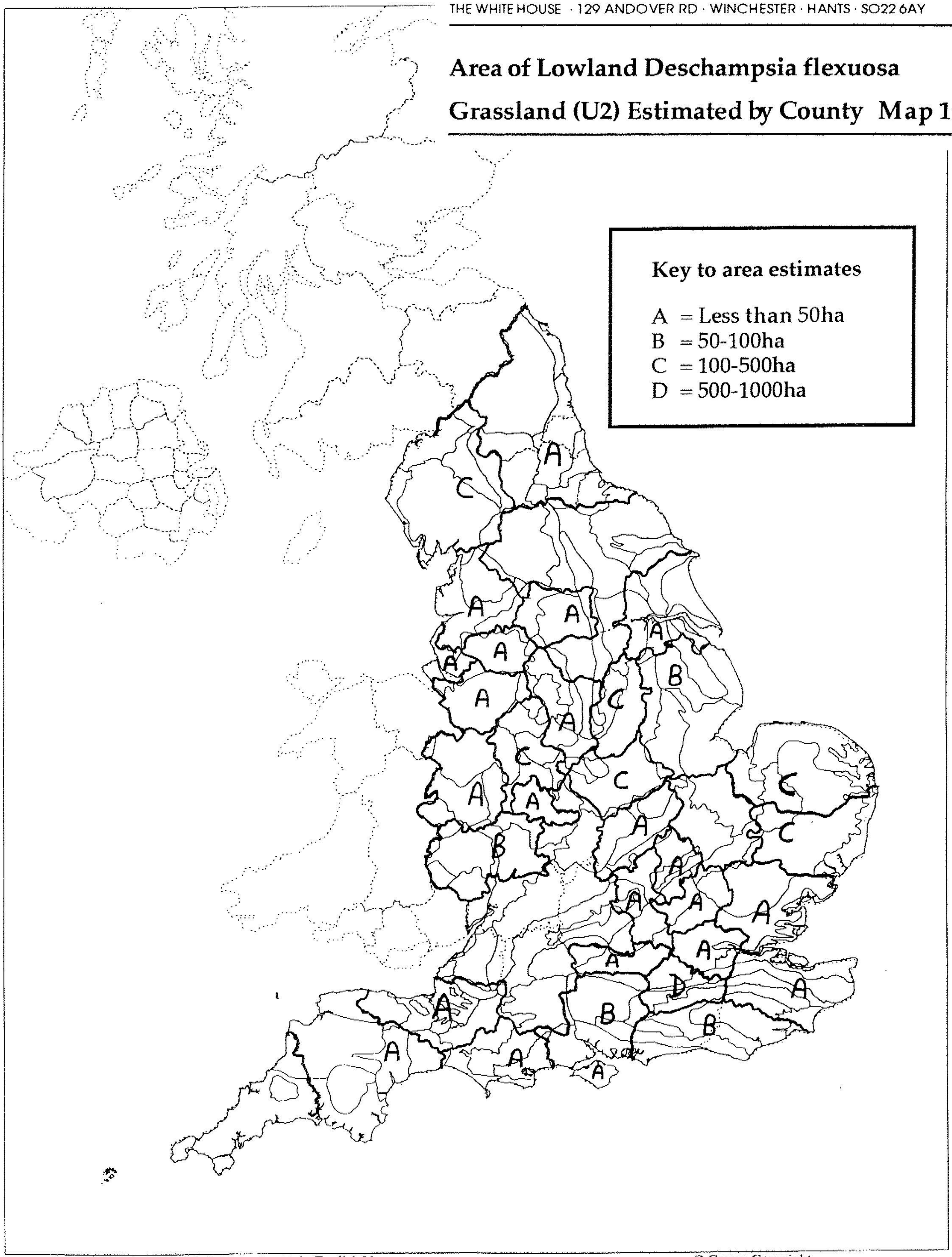
Area of Lowland Deschampsia flexuosa Grassland (U2) Estimated by County Map 19


Key to area estimates
A = Less than 50ha
B = 50-100ha
C = 100-500ha
D = 500-1000ha
A
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A
C
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C
C
A
A
C
A
B
A
A
A
A
A
A
D
A
A
B
B
A
A
A

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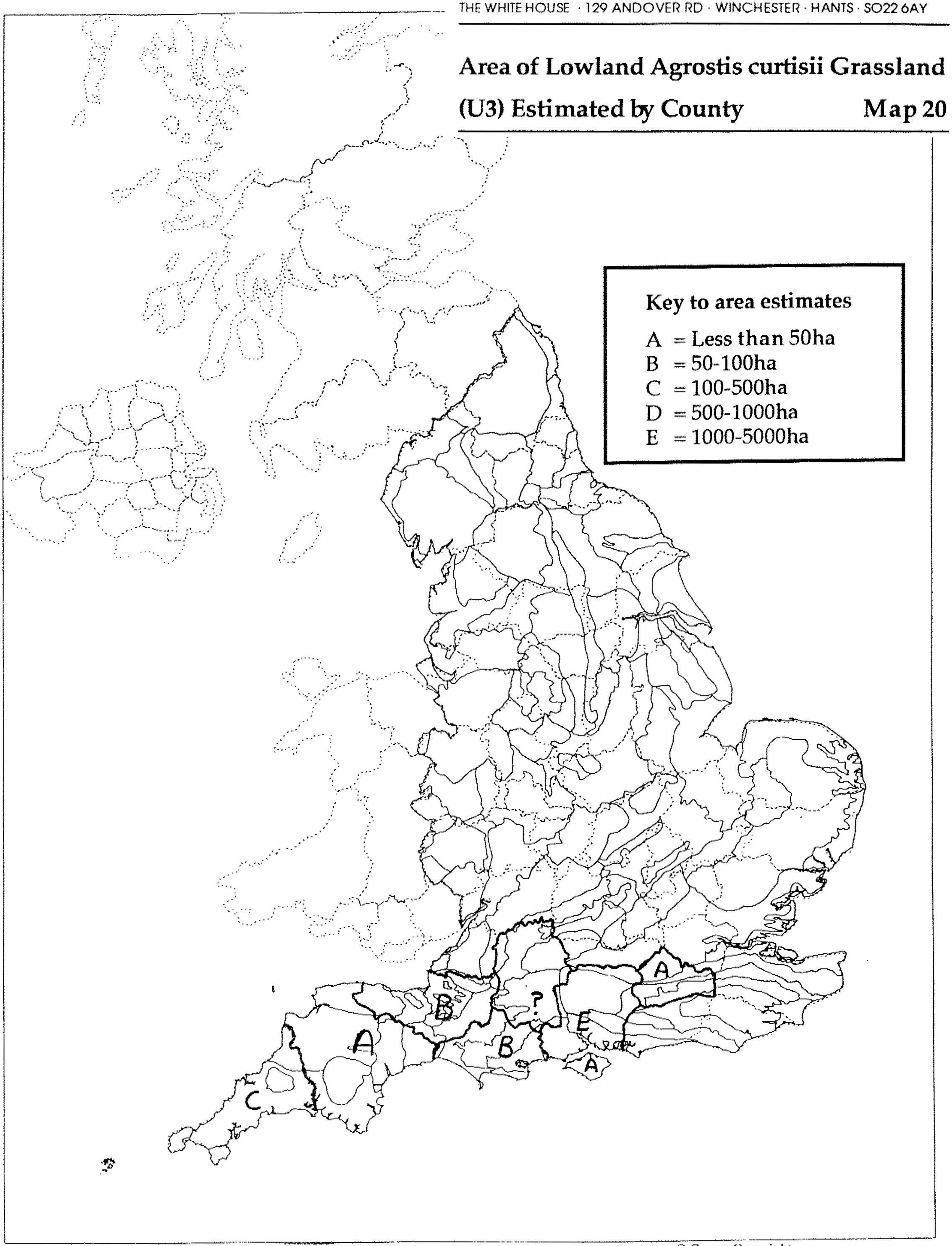
Area of Lowland Agrostis curtisii Grassland (U3) Estimated by County Map 20



Key to area estimates

A = Less than 50ha
B = 50-100ha
C = 100-500ha
D = 500-1000ha
E = 1000-5000ha

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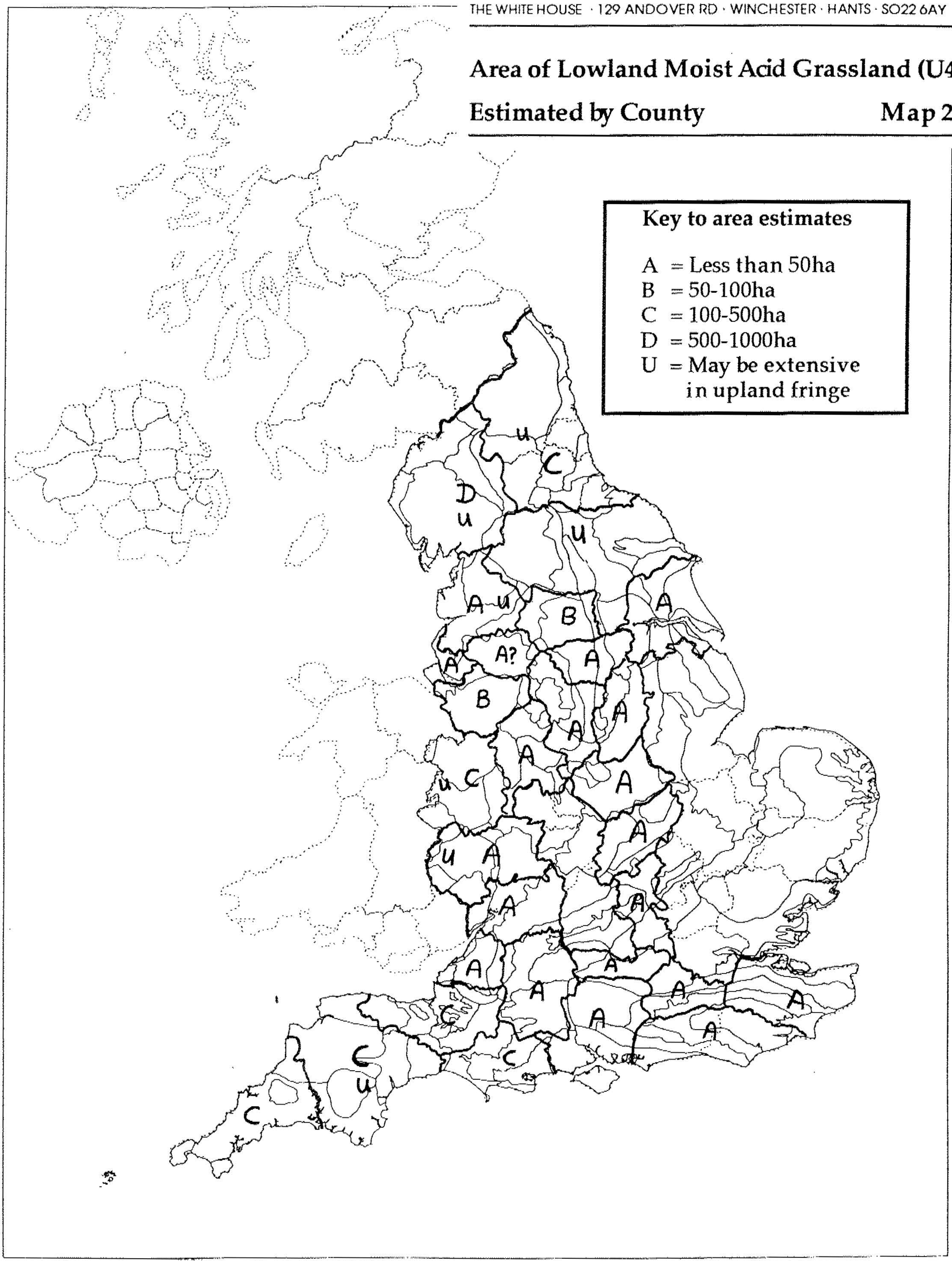
Area of Lowland Moist Acid Grassland (U4)

Estimated by County Map 21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Key to area estimates

A = Less than 50ha
B = 50-100ha
C = 100-500ha
D = 500-1000ha
U = May be extensive in upland fringe

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ECOLOGICAL PLANNING & RESEARCH
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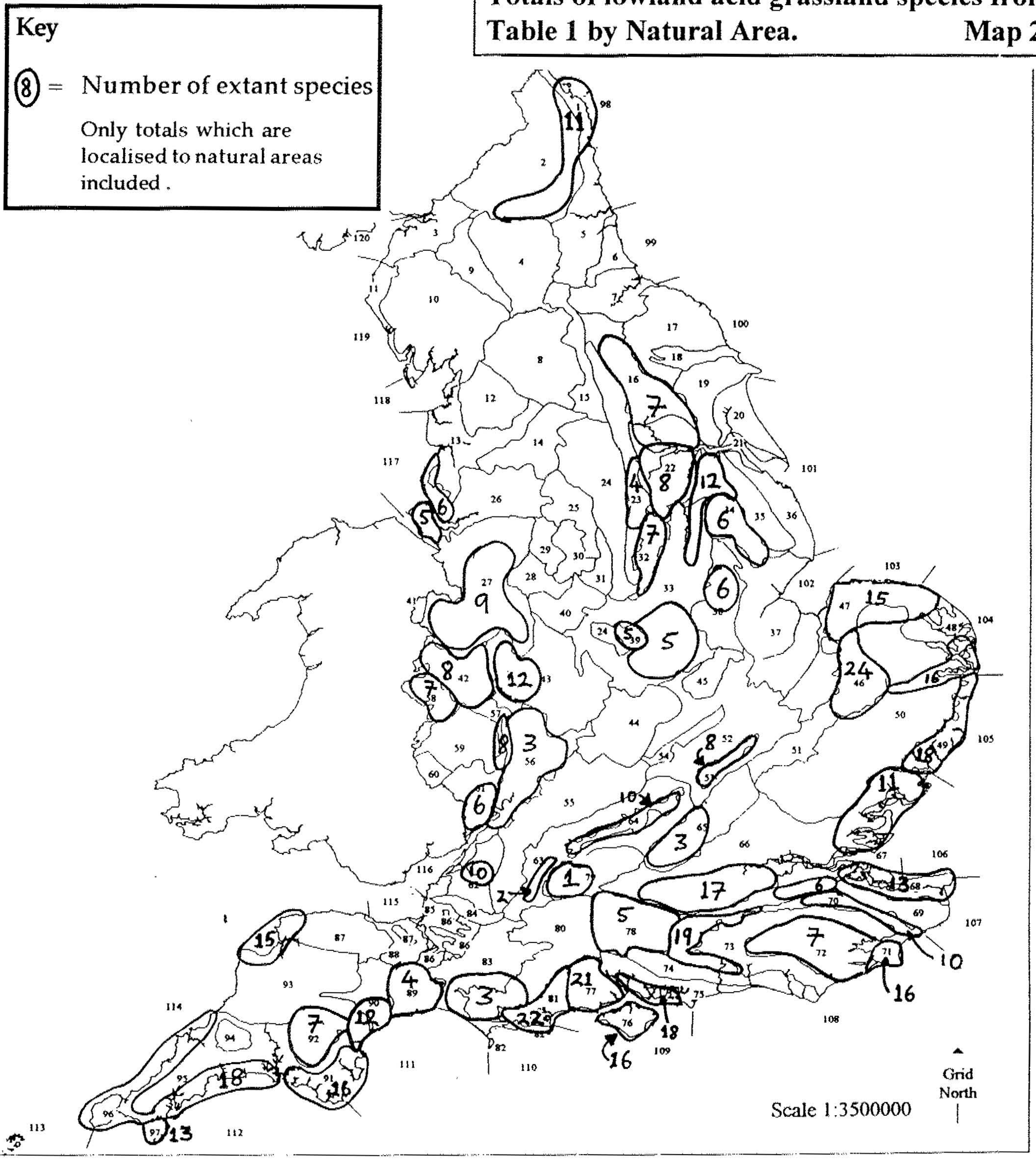
ENGLISH NATURE
Natural Areas

Totals of lowland acid grassland species from Table 1 by Natural Area. Map 22


Key

(8) = Number of extant species

Only totals which are localised to natural areas included .

Scale 1:3500000

1. North Northumberland Coastal Plain
2. Border Uplands
3. Solway Basin
4. North Pennines
5. Northumbria Coal Measures
6. Durham Magnesian Limestone Plateau
7. Tees Lowlands
8. Yorkshire Dales
9. Eden Valley
10. Cumbria Fells and Dales
11. West Cumbria Coastal Plain
12. Forest of Bowland
13. Lancashire Plain and Valleys
14. Southern Pennines
15. Pennine Dales Fringe
16. Vale of York and Mowbray
17. North York Moors and Hills
18. Vale of Pickering
19. Yorkshire Wolds
20. Holderness
21. Humber Estuary
22. Humberhead Levels
23. Southern Magnesian Limestone
24. Coal Measures
25. Dark Peak
26. Urban Mersey Basin
27. Mosses and Meres
28. Potteries and Churnet Valley
29. South West Peak
30. White Peak
31. Derbyshire Peak Fringe and Lower Derwent
32. Sherwood
33. Trent Valley and Rises
34. North Lincolnshire Coversands and Clay Vales
35. Lincolnshire Wolds
36. Lincolnshire Coast and Marshes
37. The Fens
38. Lincolnshire and Rutland Limestone
39. Charnwood
40. Needwood and South Derbyshire Claylands
41. Oswestry Uplands
42. Shropshire Hills
43. Midlands Plateau
44. Midland Clay Pastures
45. Rockingham Forest
46. Breckland
47. North Norfolk
48. The Broads
49. Suffolk Coast and Heaths
50. East Anglian Plain
51. East Anglian Chalk
52. West Anglian Plain
53. Bedfordshire Greensand Ridge
54. Yardley-Whittlewood Ridge
55. Cotswolds
56. Severn and Avon Vales
57. Malvern Hills and Teme Valley
58. Clun and North West Herefordshire Hills
59. Central Herefordshire
60. Black Mountains and Golden Valley

61. Dean Plateau and Wye Valley
62. Bristol, Avon Valleys and Ridges
63. Thames and Avon Vales
64. Midvale Ridge
65. Chilterns
66. London Basin
67. Greater Thames Estuary
68. North Kent Plain
69. North Downs
70. Wealden Greensand
71. Romney Marshes
72. High Weald
73. Low Weald and Pevensey
74. South Downs
75. South Coast Plain and Hampshire Lowlands
76. Isle of Wight
77. New Forest
78. Hampshire Downs
79. Berkshire and Marlborough Downs
80. South Wessex Downs
81. Dorset Heaths
82. Isles of Portland and Purbeck
83. Wessex Vales
84. Mendip Hills
85. Somerset Levels and Moors
86. Mid Somerset Hills
87. Exmoor and the Quantocks
88. Vale of Taunton and Quantock Fringes
89. Blackdowns
90. Devon Redlands
91. South Devon
92. Dartmoor
93. The Culm
94. Bodmin Moor
95. Cornish Killas and Granites
96. West Penwith
97. The Lizard
98. Northumberland Coast
99. Tyne to Tees Coast
100. Saltburn to Bridlington
101. Bridlington to Skegness
102. The Wash
103. Old Hunstanton to Sheringham
104. Sheringham to Lowestoft
105. Suffolk Coast
106. North Kent Coast
107. East Kent Coast
108. Folkestone to Selsey Bill
109. Solent and Poole Bay
110. South Dorset Coast
111. Lyme Bay
112. Start Point to Land's End
113. Isles of Scilly
114. Land's End to Minehead
115. Bridgwater Bay
116. Severn Estuary
117. Liverpool Bay
118. Morecambe Bay
119. Cumbrian Coast
120. Solway Firth

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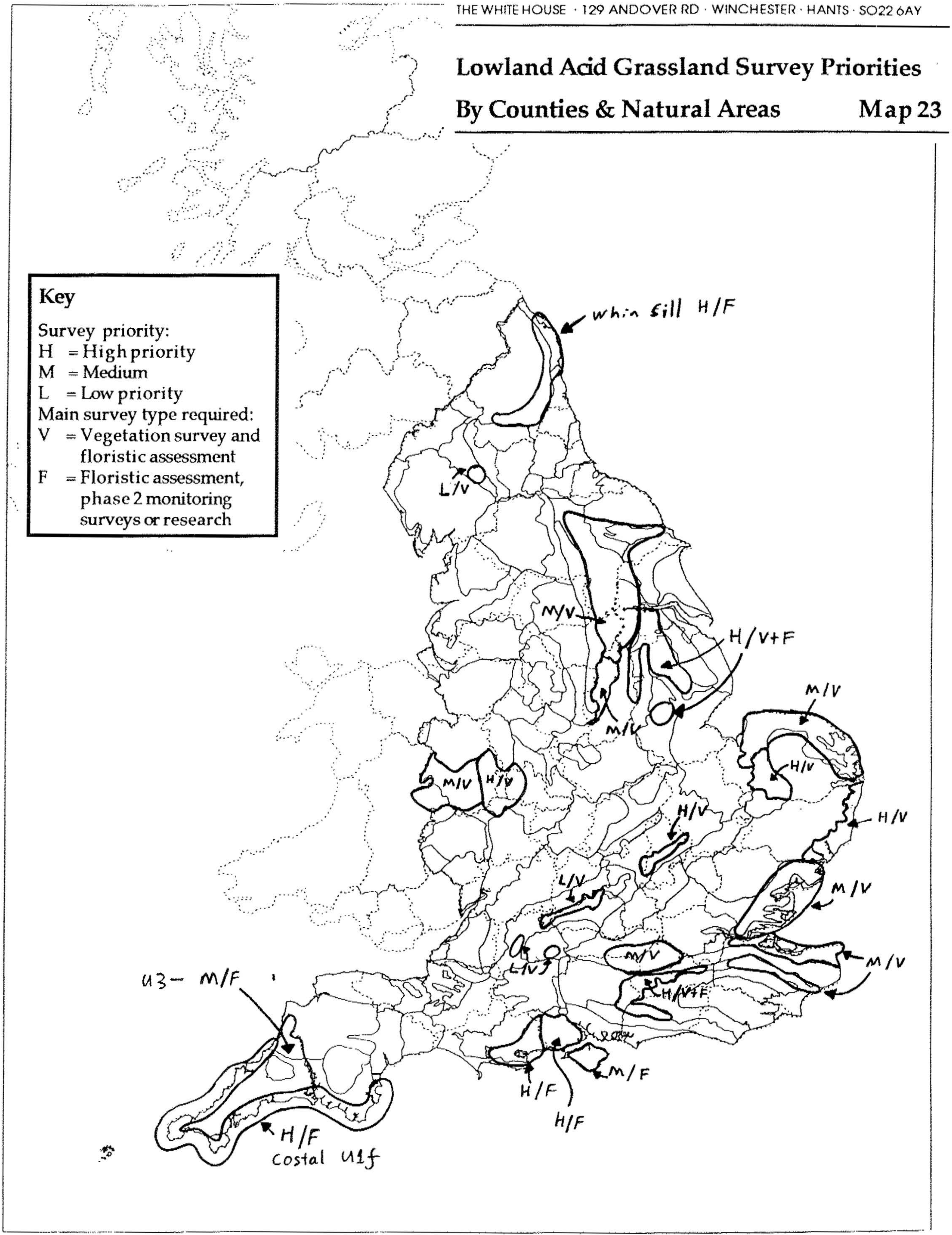
Lowland Acid Grassland Survey Priorities

By Counties & Natural Areas Map 23


Key
Survey priority:
H = High priority
M = Medium
L = Low priority
Main survey type required:
V = Vegetation survey and floristic assessment
F = Floristic assessment, phase 2 monitoring surveys or research
whin sill H/F
L/V
M/V
H/V+F
M/V
M/V
H/V
M/V
H/V
H/V
H/V
L/V
M/V
M/V
L/V
M/V
H/V+F
U3- M/F
M/F
H/F
H/F
H/F
Costal U1f

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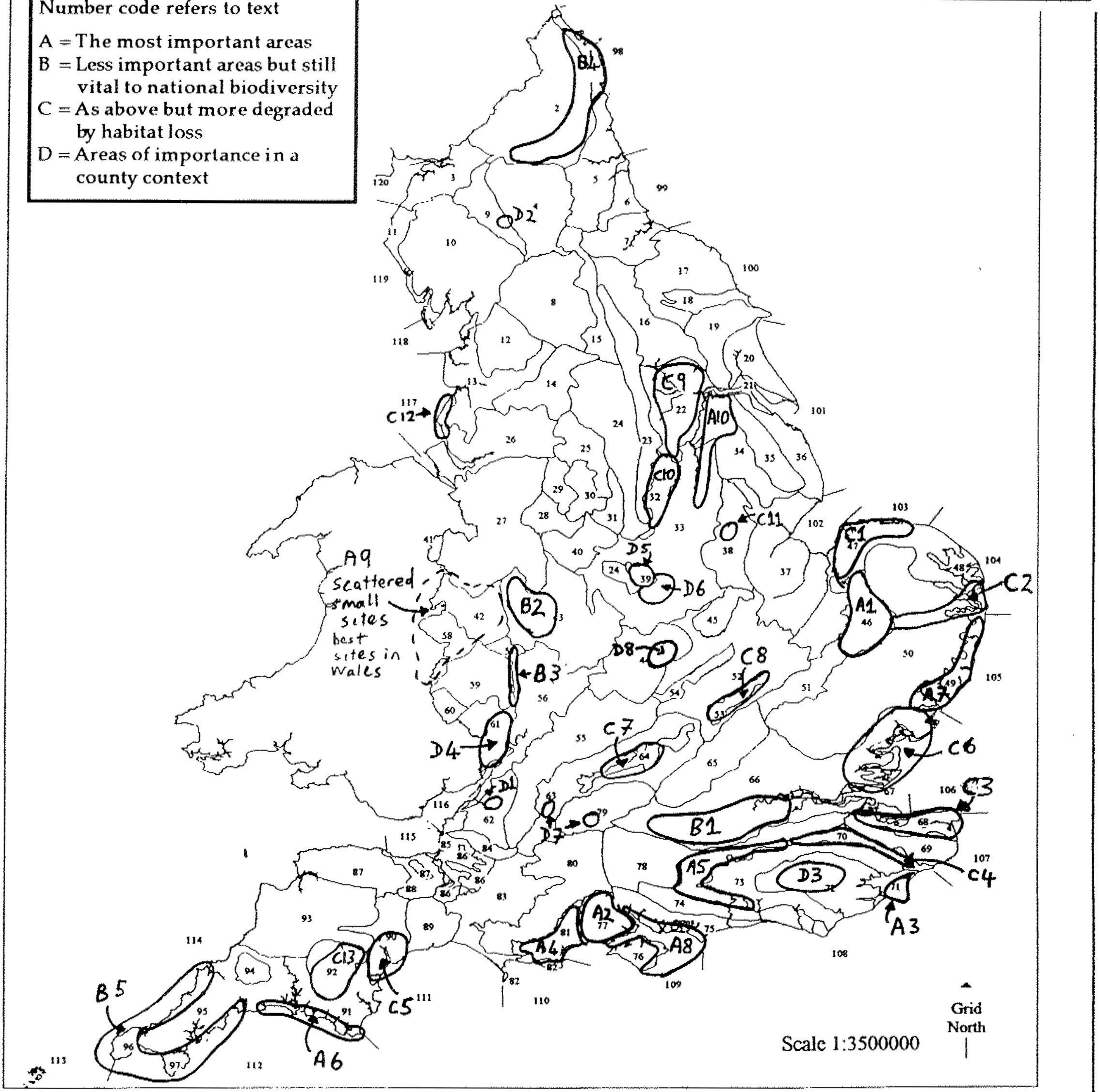
Lowland Acid Grassland Conservation Value By Natural Areas

Map 24

Key

Number code refers to text

A = The most important areas
B = Less important areas but still vital to national biodiversity
C = As above but more degraded by habitat loss
D = Areas of importance in a county context



1. North Northumberland Coastal Plain
2. Border Uplands
3. Solway Basin
4. North Pennines
5. Northumbria Coal Measures
6. Durham Magnesian Limestone Plateau
7. Tees Lowlands
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17. North York Moors and Hills
18. Vale of Pickering
19. Yorkshire Wolds
20. Holderness
21. Humber Estuary
22. Humberhead Levels
23. Southern Magnesian Limestone
24. Coal Measures
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28. Potteries and Churnet Valley
29. South West Peak
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58. Clun and North West Herefordshire Hills
59. Central Herefordshire
60. Black Mountains and Golden Valley

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88. Vale of Taunton and Quantock Fringes
89. Blackdowns
90. Devon Redlands
91. South Devon
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93. The Culm
94. Bodmin Moor
95. Cornish Killas and Granites
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101. Bridlington to Skegness
102. The Wash
103. Old Hunstanton to Sheringham
104. Sheringham to Lowestoft
105. Suffolk Coast
106. North Kent Coast
107. East Kent Coast
108. Folkestone to Selsey Bill
109. Solent and Poole Bay
110. South Dorset Coast
111. Lyme Bay
112. Start Point to Land's End
113. Isles of Scilly
114. Land's End to Minehead
115. Bridgwater Bay
116. Severn Estuary
117. Liverpool Bay
118. Morecambe Bay
119. Cumbrian Coast
120. Solway Firth

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Tables

Table 1. Species generally faithful to lowland acid grassland habitats in England

Grasses

Apera interrupta *

Corynephorus canescens **

Festuca longifolia **

Vulpia ciliata ambigua *

Other vascular plants

Chamaemelum nobile *

Crassula tillaea *

Dianthus deltoides *

Erodium maritimum

Filago minima (NUD)

Gladiolus illyricus **

Herniaria glabra **

Hypochaeris glabra *

Lotus angustissimus **

Lotus subbiflorus *

Medicago minima *

Moenchia erecta

Ornithopus perpusillus (NUD)

Potentilla argentea

Sagina subulata (NUD)

Scleranthus perennis prostratus **

Silene conica *

Stellaria pallida (NUD)

Teesdalia nudicaulis

Thymus serpyllum **

Trifolium glomeratum *

Trifolium ornithopodioides

Trifolium scabrum (NUD)

Trifolium striatum (NUD)

Trifolium subterraneum (NUD)

Trifolium suffocatum *

Veronica verna **

Vicia lathyroides (NUD)

Viola lactea *

Total number of taxa = 33, *Nationally scarce species = 12, **Nationally rare = 8

(NUD) = Species not up dated on the Biological Record Centre maps

Table 2. Species locally characteristic of lowland acid grassland in England but which are also found in other habitats

Dwarf shrubs

Rosa pimpinellifolia
Ulex minor

Grasses

Aira caryophyllea
Aira praecox
Cynodon dactylon **
Koeleria macrantha
Poa bulbosus *

Other vascular plants

Allium schoenoprasum *
Aphanes inexspectata
Astragalus danicus
Botrychium lunaria
Carex arenaria
Carex montana *
Cerastium arvense
Cerastium diffusum
Cerastium semidecandrum
Cuscuta epithymum
Dianthus armeria *
Echium vulgare
Erigeron acer
Erodium cicutarium
Erodium moschatum *
Euphrasia vigursii **
Filago vulgaris
Gentianella campestris
Gnaphalium luteoalbum **
Hypericum linariifolium **
Jasione montana
Lepidium heterophyllum
Medicago polymorpha *
Muscari neglecta **
Myosotis ramosissima
Parentucellia viscosa
Petrorhagia nanteuilii **
Petrorhagia prolifera **
Plantago coronopus
Potentilla neumanniana *
Radiola linoides
Sagina nodosa
Scilla autumnalis *
Scleranthus annuus annuus
Scleranthus annuus polycarpus
Sedum acre
Sedum anglicum
Sedum fosterianum *
Sherardia arvensis
Silene nutans *
Silene otites **
Spergularia rubra
Spiranthes spiralis
Trifolium arvense
Umbilicus rupestris
Veronica spicta spicta **
Viola canina

Mosses

Campylopus polytrichoides *
Hypnum lacunosum tectorum
Leptodontium gemmascens **
Racomitrium elongatum
Rhynchostegium megapolitanum
Scleropodium tourettii
Tortula ruralis ruraliformis

Liverworts

Ptilidium ciliare

Lichens

Cladonia arbuscula
Cladonia cariosa *
Cladonia ciliata
Cladonia crispata
Cladonia foliacea
Cladonia gracilis
Cladonia uncialis
Coelocaulon aculeatum
Icmadophila ericetorum
Peltigera canina *
Peltigera rufescens
Usnea articulata

Total number of taxa = 73, *Nationally scarce species = 13, **Nationally rare = 10

Table 2 continued

Additional species locally characteristic of parched acid grasslands in Wales
Vascular plants
Gagea bohemica **
Lychnis viscaria **
Potentilla rupestris **
Scleranthus perennis perennis **
Trifolium strictum **
Veronica spicata hybrida *
Mosses
Bartramia stricta **

Table 3. Species of ephemeral ponds often associated with acid grasslands

Vascular plants
*Cicendia filiformis**
*Galium constrictum***
*Illecebrum verticillatum**
*Ludwigia palustris***
*Pilularia globulifera**
*Pulicaria vulgaris***
Mosses
*Physcomitrium eurystomum***
Liverworts
*Fossombronia foveolata**
Total number of species = 8 * Nationally scarce = 4 **Nationally Rare = 4

Table 4. Species of disturbed acid sandy soils

Vascular plants
Arabis glabra *
Apera spica-venti *
Filago lutescens **
Medicago sativa falcata *
Silene gallica *
Veronica praecox
Veronica triphyllos **
Total number of species = 7 * Nationally scarce = 4 **Nationally Rare = 3

Table 5. Summary of estimated areas of lowland acid grassland by county

County	AG	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Avon	B	A						A					A										
Bedfordshire	A	A		A			A		A														
Berkshire	C	B		A		A	A	B	A	A			A	A									
Buckinghamshire	A								A	A			A										
Cambridgeshire	A	A	A	?		A	A																
Cheshire	B	A				A			A				B										
Cornwall	C	A					+	A				C	C	+	+			+					+
Cumbria	D	C					C		C				D							A			+
Derbyshire	A								A				A		A	A		A	A				
Devon	C	A					A	A	A			A	C	+	+			+					+
Dorset	D	B	?	A	?	A	A	A	A	A		B	C	A	B	?							A
Essex	C	C	?	+		+	+		A														
Gloucestershire	C	B		A	?	A	A	A					A	A	A	A	A		A				
Greater London	D	D		+		+	+		A		?												
Greater Manchester	B	A					A	A	A				A?						A				
Hampshire	E	E	A	B	A	D	A	D	B	B		E	A								A	A	C
Hereford & Worcs.	D	C	A	+		+	+		B	B			A	A	A								+
Hertfordshire	C	B		+		+	+		A														
Humberside	C	C	A	A	B	A		A	A	A			A	A	A				A	A	A	A	
Isle of Wight	C	C		A		A		A	A	A		A											+
Kent	D	D	C	B/D		B	B/D	A	A	A			A										
Lancashire	B	A				A			A				A						A				
Leicestershire	C	A		A					C	C			A		A								
Lincolnshire	C	C	+	+		+			B	+											A	A	
Merseyside	C	A		A		A			A				A						A				
NE England	C	B	?	+	?				A				C	+				+					
Norfolk	E	E	+	+	+	+	+		C	C									A		B	A	
Northamptonshire	A	A							A	A			A		A								
North Yorkshire	A	A																					
Nottinghamshire	C	A		A			A		C	C			A		A				A		A		
Oxfordshire	A	A		?																			
Shropshire	C	B		+		+	+	+	A	A			C	+					A				
Somerset	D	B							A			B	C										+
South Yorkshire	A	A											A						A				
Staffordshire	C	A		A	?		?		C				A										
Suffolk	E	D	B	C		C	B		C	C											B	A	
Surrey	D	C		+		+	+		D			A	A								A	A	
Sussex (E & W)	D	C	A	A		A	C	A	B	B			A	A	A								
Warwickshire	A	?																					
West Midlands	B								A										A				
West Yorkshire	B	A					A		A				B						A				
Wiltshire	A	A		?			A	A				?	A		A								
England	G	F/G	D	E	B	E	E	E	E/F	E/F		E	E	C	C/D	A/B	A	A	C	A	C	B/C	C

A = Less than 50ha, B = 50-100 ha, C = 100-500ha, D = 500-1,000ha, E = 1,000-5,000 ha, F = 5,000-10,000 ha, G = Greater than 10,000 ha
+ = Present but area not known, ? = may be present

Table 6. Numbers of lowland acid grassland species recorded in selected areas

County/Area	Avon	Beds	Berks & Oxfordshire			Cambs	Cheshire, Gloucs, Her&Worcs, Shrops, Staffs, Warwicks							Cornwall			Cumbria
Natural Area	**All**	**53**	**66**	**64**	**65**	**All**	**43**	**57**	**61**	**56**	**58**	**42**	**27**	**95+96**	**97**	**113**	**All**
Grasses																	
Apera interrupta				1		1											
Corynephorus canescens							1										
Festuca longifolia																	
Vulpia ciliata ambigua						1											
Other Vascular Plants																	
Chamaemelum nobile	0		1	0	0		0	0	0	0	0		0	1	1	1	
Crassula tillaea						0								1			
Dianthus deltoides	0		0	1			1				1	1	1				0
Erodium maritimum	1						0	0						1	1	1	
Filago minima	1	1	1	1		1	1	1	1		1	1	1	1			1
Gladiolus illyricus																	
Herniaria glabra						1											1
Hypochaeris glabra	0	0	0	0	1	0	1	1		0		1	1	0			
Lotus angustissimus														1	0		
Lotus subbiflorus														1	1	1	
Medicago minima						1											
Moenchia erecta	1	0	1	0		0	1	1	1	0	1	1	1	1	1		0
Ornithopus perpusillus	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Potentilla argentea	0	1	1	1	0	1	1	1	1	1		1	1				1
Sagina subulata			1											1	1		
Scleranthus perennis																	
Silene conica				1		1	1										0
Stellaria pallida	1	1	1	1		1	1						1	1	0	1	1
Teesdalia nudicaulis	1	1	1	1		0	1	1		0	1	1	1	1			1
Thymus serpyllum						0											
Trifolium glomeratum														1	1	1	
Trifolium ornithopodioides	1		0					1	0	0				1	1	1	
Trifolium scabrum	1		0	0		1			0				0	1	1	1	
Trifolium striatum	1	1		1	1	1	1	1	1	0	1	1	1	1	1	1	1
Trifolium subterraneum	1	1	1	0		1			1	1				1	1	1	
Trifolium suffocatum														1	1	1	
Veronica verna																	
Vicia lathyroides		1		1		1	1				1						1
Viola lactea	0		1	0					0					1	1		
Total no. spp extant	10	8	10	10	3	13	12	8	6	3	7	8	9	18	13	11	8
Total no. spp extinct	5	2	4	6	2	5	2	2	4	6	1	0	2	1	2	0	3
Total no. spp recorded	15	10	14	16	5	18	14	10	10	9	8	8	11	19	15	11	11
Extant spp/all spp	0.7	0.8	0.7	0.6	0.6	0.7	0.9	0.8	0.6	0.3	0.9	1.0	0.8	0.9	0.9	1.0	

1 = Recent record   0 = Apparently extinct

[See end of table for key to Natural Area numbers]

Table 6 continued

County/Area	Derby	Devon					Dorset		Essex	Hampshire					Herts	IoW
Natural Area	**All**	**89**	**90**	**91**	**92**	**87+93**	**81+82**	**80+83**	**All**	**77**	**70**	**66**	**75**	**78**	**All**	**76**
Grasses																
Apera interrupta									0							
Corynephorus canescens																
Festuca longifolia																
Vulpia ciliata ambigua							1			1	1		1			1
Other Vascular Plants																
Chamaemelum nobile	0	0	0	1	1	1	1	0	0	1	1	1	1	0	0	1
Crassula tillaea				1			1			1	1	1	1			
Dianthus deltoides	1						1								1	
Erodium maritimum				1		1	1			1			0			
Filago minima	1		1	1	1	1	1		1	1	1	1	1	1	1	1
Gladiolus illyricus							0			1						0
Herniaria glabra											1					
Hypochaeris glabra			0	0		0	1		0	1	1	0	1			1
Lotus angustissimus			0	1		1	1			1			1			0
Lotus subbiflorus		0	1	1		1	1			1	0		1			
Medicago minima									0							
Moenchia erecta	0	1	1	1	0	1	1	1	1	1	1	1	1		0	1
Ornithopus perpusillus	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Potentilla argentea	1		0	0	1		1		1		1	1	0	1	1	
Sagina subulata		1	1	1	1	1	1			1		0	1			1
Scleranthus perennis																
Silene conica																
Stellaria pallida	1			1			1		1	1	1	1	1	1		1
Teesdalia nudicaulis	1	0	1	1	1	1	1		0	1	1	1	1		0	
Thymus serpyllum																
Trifolium glomeratum			1	1		1	1	0	1	1	1		0			1
Trifolium ornithopodioides			1	1		1	1	1	1	1	1	1	1		0	1
Trifolium scabrum			1	1		1	1		0	1	1		1			1
Trifolium striatum	1		1	1		1	1		1	1	1	1	1	1	1	1
Trifolium subterraneum		1	1	1		1	1		1	1	1	1	1	0	0	1
Trifolium suffocatum							1		1				1			1
Veronica verna																
Vicia lathyroides							0		1	1	1		1			1
Viola lactea		0	1	1	1	1	1			1		1				1
Total no. spp extant	7	4	12	17	7	15	22	3	11	21	17	12	18	5	5	16
Total no. spp extinct	2	4	4	2	1	1	2	2	6	0	1	2	3	2	5	2
Total no. spp recorded	9	8	16	19	8	16	24	5	17	21	18	14	21	7	10	18
Extant spp/all spp																

1 = Recent record 0 = Apparently extinct

[See end of table for key to Natural Area numbers]

Table 6 continued

County/Area	Kent			Leics		Lincs, Notts, North, South, West Yorkshire							Mersey	
Natural Area	**71**	**70**	**68**	**39**	**33**	**33+34**	**34**	**38**	**32**	**22**	**16+18+22**	**24**	**26a**	**26b**
Grasses														
Apera interrupta						1								
Corynephorus canescens													1	
Festuca longifolia						1								
Vulpia ciliata ambigua	1	1	1											
Other Vascular Plants														
Chamaemelum nobile				0	0						0	0		
Crassula tillaea						1								
Dianthus deltoides					0		0			0	1			0
Erodium maritimum														
Filago minima	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gladiolus illyricus														
Herniaria glabra								1						
Hypochaeris glabra	0			0		1	0	0	1	1	0		0	
Lotus angustissimus			1											
Lotus subbiflorus														
Medicago minima	1													
Moenchia erecta	1	1	1	1	1	0			0	0	0	0	0	0
Ornithopus perpusillus	1	1	1	1	1	1	1	1	1	1		1	1	1
Potentilla argentea		1	1	1	1	1	1	1	1	1	0			
Sagina subulata		0												0
Scleranthus perennis														
Silene conica	1													
Stellaria pallida	1	1	1	0	0	1		0		1	1		1	1
Teesdalia nudicaulis	1			0	0	1	1		1	1	1	0	1	0
Thymus serpyllum														
Trifolium glomeratum		1	1											
Trifolium ornithopodioides	1	1	1					0						1
Trifolium scabrum	1		1		0			1			1	1		
Trifolium striatum	1	1	1	1	1	1	1	1	1	1	1	1	0	1
Trifolium subterraneum	1	1	1	0	0	1								0
Trifolium suffocatum	1													
Veronica verna														
Vicia lathyroides	1		1			1	1		1	1	1		1	0
Viola lactea														
Total no. spp extant	14	10	13	5	5	12	6	6	7	8	7	4	6	5
Total no. spp extinct	1	1	0	5	6	1	2	3	1	2	4	3	3	6
Total no. spp recorded	15	11	13	10	11	13	8	9	8	10	11	7	9	11
Extant spp/all spp	0.9	0.9	1.0	0.5	0.5	0.9	0.8	0.7	0.9	0.8	0.6	0.6	0.7	0.5

1 = Recent record 0 = Apparently extinct

[See end of table for key to Natural Area numbers]

Table 6 continued

County/Area	Norfolk & Suffolk				Northants	NE England	Somerset	Surrey			Sussex			Wilts	
Natural Area	**46**	**47+50**	**49**	**50+48**	**All**	**1+2**	**All**	**70**	**66**	**69**	**70**	**72**	**71**	**64**	**79**
Grasses															
Apera interrupta	1	1	1	0											
Corynephorus canescens	1			0											
Festuca longifolia	1														
Vulpia ciliata ambigua	1	1	1	1			1	1							
Other Vascular Plants															
Chamaemelum nobile	0	0	0	0			1	1	1	1	1	1			0
Crassula tillaea	1	1	1	1			1		0						
Dianthus deltoides	1	0	0			1		1	1						
Erodium maritimum							1								
Filago minima	1	1	1	1	0	1	0	1	1	1	1	1		0	
Gladiolus illyricus															
Herniaria glabra	1	0													
Hypochaeris glabra	1	1	1	1	0		1	1	1		1		1	0	
Lotus angustissimus															
Lotus subbiflorus															
Medicago minima	1	1	1	0									1		
Moenchia erecta	0	0	1	1	0	1	1	1	1		1	1	1		0
Ornithopus perpusillus	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Potentilla argentea	1	1	1	1		1		1	1		1		0		
Sagina subulata		0				1	1	1	0		0	0			
Scleranthus perennis	1	0			0										
Silene conica	1	1	0	1			1								
Stellaria pallida	1	1	1	1	1	1	1	1				1	1		
Teesdalia nudicaulis	1	1	1	1	0	1	1	1	1		1	0	1	0	
Thymus serpyllum	1														
Trifolium glomeratum	1	0	1	1			0						1		
Trifolium ornithopodioides			1	1			1	1	1	1	1		1		
Trifolium scabrum	1	1	1	1		1	1	1	1		1		1		0
Trifolium striatum	1	1	1	1	1	1	1	1	1	1	1		1	1	
Trifolium subterraneum	1	1	1				1	1	1	1	1	1	1		
Trifolium suffocatum	1		1	1			1						1		
Veronica verna	1		0												
Vicia lathyroides	1	1	1	1		1	1	1	1				1		
Viola lactea							1		0			1			
Total no. spp extant	24	15	18	16	3	11	18	16	13	6	11	7	13	2	1
Total no. spp extinct	2	7	4	4	5	0	2	0	3	0	1	2	1	3	3
Total no. spp recorded	26	22	22	20	8	11	20	16	16	6	12	9	14	5	4
Extant spp/all spp	0.9	0.7	0.8	0.8	0.4	1.0	0.9	1.0	0.8	1.0	0.9	0.8	0.9	0.4	0.3

1 = Recent record 0 = Apparently extinct

[See end of table for key to Natural Area numbers]

Key to Natural Area numbers. Old Natural Area codes are in brackets. Some Natural Area names have been abbreviated.

Bedfordshire

53 = Bedfordshire Greensand Ridge (26)

Berkshire & Oxfordshire

66 = London Basin (38)
64 = Midvale Ridge (36)
65 = Chilterns (34)

Cheshire, Gloucs, Hereford & Worcs, Shrops, Staff, Warwicks

43 = Midlands Plateau (75)
57 = Malvern Hills (71)
61 = Dean Plateau (72)
56 = Severn & Avon Vales (70)
58 = Clun (77)
42 = Shropshire Hills (76)
27 = Mosses & Meres (79)

Cornwall

95 = Killas & Granites (59)
97 = The Lizard (60)
113 = Isles of Scilly (M17)

Devon

89 = Blackdowns (55)
90 = Devon Redlands (56)
91 = South Devon (57)
92 = Dartmoor (61)
87+93 = Exmoor/The Culm (62/63)

Dorset

81+82 = Dorset Heaths/Isles of Portland and Purbeck (52/53)
80+83 = South Wessex Downs/Wessex Vales (51/54)

Hampshire

77 = New Forest (50)
70 = Wealden Greensand (46)
66 = London Basin (38)
75 = South Coast Plain (48)
78 = Hampshire Downs

Isle of Wight

76 = Isle of Wight

Kent

71 = Romney Marshes (42)
70 = Greensand (46)
68 = North Kent Plain (40/41)

Leicestershire

39 = Charnwood (19)
33 = Trent Valley and Rises (18)

Lincs, Notts, North, South, West Yorkshire

33+34 = N. Lincs Coversands/Trent Valley (part) (16)
34 = N. Lincs Coversands and Clay Vales (part) (21)
38 = Lincs Limestone (20)
32 = Sherwood (17)
22 = Humberhead Levels (15)
16+18+22 = Vale of York/Vale of Pickering/Humberhead Levels (8)
24 = Coal Measures (13)

Merseyside

26a = Urban Mersey Basin (Sefton Coast) (86)
26b = Urban Mersey Basin (The Wirral) (86)

Norfolk and Suffolk

46 = Breckland (29)
47+50 = North Norfolk (30/33)
49 = Suffolk Coast and Heaths (32)
50+48 = East Anglian Plain & Broads (River Waveney) (33/31)

NE England

1+2= N. Northumberland Coastal Plain/Border Uplands (Whin Sill) (1/2)

Surrey

70 = Wealden Greensand (46)
66 = London Basin (38)
69 = North Downs (41)

Sussex

70 = Wealden Greensand (46)
72 = High Weald (44)
71 = Romney Marshes (42)

Wiltshire

64 = Midvale Ridge (36)
79 = Berkshire Downs (37)

Table 7 Areas of England ranked by number of lowland acid grassland species

Extant spp	Area	New/*Old* Natural Area code
24	Breckland of East Anglia	NA 46/*NA29*
22	The Dorset Heaths	NA81 & 82/*NA52 & 53*
21	The New Forest, Hampshire	NA77/*NA50*
19	Wealden Greensand of Hampshire, Sussex & Surrey	NA70/*NA46*
18	The Sandlings, East Anglia	NA49/*NA32*
18	The South Coast Plain, Hampshire	NA75/*NA48*
18	Somerset (mainly coastal sand dunes)	All NAs in county
18	Cornwall, coastal cliff tops	NA95 & 96/*NA59*
17	South Devon (mainly coastal cliff top grassland)	NA91/*NA57*
17	Thames Valley Heaths, Surrey, Berkshire & Hampshire	NA66/*NA38*
16	Broads & River Waveney, East Anglia	NA50 & 48/*NA33 & 31*
16	Dungeness, Kent & Sussex	NA71/*NA42*
16	Isle of Wight	NA76/*NA49*
15	North Norfolk, including Greensand areas	NA50 & 47/*NA30 & 33*
15	North coast of Devon	NA87 & 93/*NA62 & 63*
13	Cambridgeshire	NA46, 51 & 53/*NA26, 28 & 29*
13	The Lizard, Cornwall	NA97/*NA60*
13	North Kent Plain	NA68/*NA40 & 41*
12	Devon Redlands	NA90/*NA56*
12	Kidderminster Heaths, Her & Worcs, Shrops., Staff.	NA43/*NA75*
12	Coversand of Lincs, Notts, Yorks	NA33 & 34/*NA16*
11	Essex (mainly in north east)	NA66/*NA50*
11	Isles of Scilly, Cornwall	NA113/*M17*
11	Whin Sill, North East England	NA1 & 2/*NA1 & 2*
10	Midvale Ridge, Oxfordshire	NA64/*NA36*
10	Avon	NA62/*NA68*
10	Wealden Greensand, Kent	NA70/*NA46*
9	Mosses & Meres, (mainly in Shropshire)	NA27/*NA79*
8	Cumbria	All NAs in county
8	Bedfordshire Greensand Ridge	NA53/*NA26*
8	Humberhead Levels in Lincs, Notts, Yorks	South part of NA22/*NA15*
8	Malvern Hills, Hereford & Worcs	NA57/*NA71*
8	Shropshire Hills	NA42/*NA76*
7	Vales of Yorkshire	NA16, 18 & 22/*NA8*
7	Derbyshire	All NAs in county
7	The High Weald, Sussex	NA72/*NA44*
7	Dartmoor, Devon	NA92/*NA61*
7	Sherwood Forest, Notts	NA32/*NA17*
7	Clun and North West Herefordshire Hills	NA58/*NA77*
6	Forest of Dean, Gloucs	NA61/*NA72*
6	Lincolnshire Limestone	NA38/*NA20*
6	Sefton Coast, Mersey Basin	NA26/*NA86*
6	Lincolnshire Clay Vales (outside Coversand areas)	NA34/*NA21*
6	North Downs, Surrey	NA69/*NA41*
5	Trent Valley and Rises, Leics	NA33/*NA18*
5	The Wirral, Mersey Basin	NA26/*NA86*
5	Hertfordshire	All NAs in county
5	Charnwood Forest, Leics	NA39/*NA19*
5	Hampshire Downs	NA78/*NA47*
4	Blackdowns, Devon, Somerset, Dorset	NA89/*NA55*
4	Coal Measures, West Yorkshire	NA24/*NA13*
3	Severn and Avon Vales, Gloucs, Hereford & Worcs	NA56/*NA70*
3	Northamptonshire	All NAs in county
3	Chilterns, Berks and Oxfordshire	NA65/*NA34*
3	Wessex Vales and South Wessex Downs, West Dorset	NA80 & 83/*NA51 & 54*
2	Greensand outcrops, Thames & Avon Vales, Wilts	NA63/*NA36*
1	Marlborough Downs, Wilts	NA97/*NA37*

Table 8 Provisional indicator species list for lowland dry acid grassland

Taxa recorded from English acid grassland

Dwarf shrubs

Rosa pimpinellifolia
Ulex minor

Grasses

Aira caryophyllea
Aira praecox
Apera interrupta
Corynephorus canescens
Cynodon dactylon
Festuca longifolia
Koeleria macrantha
Poa bulbosus
Vulpia ciliata ambigua

Other vascular plants

Allium schoenoprasum
Aphanes inexspectata
Astragalus danicus
Botrychium lunaria
Carex arenaria
Carex montana
Cerastium arvense
Cerastium diffusum
Cerastium semidecandrum
Chamaemelum nobile
Crassula tillaea
Cuscuta epithymum
Dianthus armeria
Dianthus deltoides
Echium vulgare
Erigeron acer
Erodium cicutarium
Erodium maritimum
Erodium moschatum
Euphrasia vigursii
Filago minima
Filago lutescens
Filago vulgaris
Gentianella campestris
Gladiolus illyricus
Gnaphalium luteoalbum
Herniaria glabra
Hypericum linariifolium
Hypochaeris glabra
Jasione montana
Lepidium heterophyllum
Lotus angustissimus
Lotus subbiflorus
Medicago minima
Medicago polymorpha
Moenchia erecta
Muscari neglecta
Myosotis ramosissima
Ornithopus perpusillus
Parentucellia viscosa
Petrorhagia nanteuilii
Petrorhagia prolifera
Plantago coronopus
Potentilla argentea
Potentilla neumanniana
Radiola linoides
Sagina nodosa
Sagina subulata
Scilla autumnalis
Scleranthus annuus annuus
Scleranthus annuus polycarpus
Scleranthus perennis prostratus
Sedum acre
Sedum anglicum
Sedum fosterianum
Sherardia arvensis
Silene conica
Silene nutans
Silene otites
Spergularia rubra
Spiranthes spiralis
Stellaria pallida
Teesdalia nudicaulis
Thymus serpyllum
Trifolium arvense
Trifolium glomeratum
Trifolium ornithopodioides
Trifolium scabrum
Trifolium striatum
Trifolium subterraneum
Trifolium suffocatum
Umbilicus rupestris
Veronica spicata spicata
Veronica verna
Vicia lathyroides
Viola canina
Viola lactea

Mosses

Campylopus polytrichoides
Hypnum lacunosum tectorum
Leptodontium gemmascens
Racomitrium elongatum
Rhynchostegium megapolitanum
Scleropodium tourettii
Tortula ruralis ruraliformis

Liverworts

Ptilidium ciliare

Lichens

Cladonia arbuscula
Cladonia cariosa
Cladonia ciliata
Cladonia crispata
Cladonia foliacea
Cladonia gracilis
Cladonia uncialis
Coelocaulon aculeatum
Icmadophila ericetorum
Peltigera canina
Peltigera rufescens
Usnea articulata

Total number of taxa = 108

Additional species that could be used in Wales

Vascular plants

Gagea bohemica
Lychnis viscaria
Potentilla rupestris
Scleranthus perennis perennis
Trifolium strictum
Veronica spicata hybrida

Mosses

Bartramia stricta

Total number of taxa = 115

The list is intended primarily to cover parched acid grasslands, NVC community U1. Some species more typical of other types are also included, eg *Gladiolus illyricus*, found in species-rich Bracken stands and *Icmadophila ericetorum* found in U2 grassland, but these other communities generally have lower floristic richness and are not so readily assessed by using this provisional list. Several species are locally typical of high quality examples of U1 grasslands but are normally regarded as calcicoles, but, in at least parts of the country, are more catholic. To include these in the main indicator list could be confusing so they are included below as bonus species.

Bonus species (all vascular plants)
Carduus nutans
Carlina vulgaris
Clinopodium acinos
Linum catharticum
Linum bienne
Thymus polytrichus
Thymus pulegioides

Habitats with U1 grassland in southern and eastern England containing over 10 species could be regarded as being of high nature conservation significance and those with over 20 as being exceptional sites for their acid grassland flora.

Appendix 1. Examples of lowland acid grasslands

Introduction

The following sites were selected as examples of the main types of acid grassland found in lowland England. Some were surveyed by the contractor, others were extracted from existing reports. Quadrat samples of characteristic acid grassland stands are given as well as brief site descriptions. In some cases plant community lists are also included. Full details of the sites surveyed by the contractor have been sent to the relevant Local Teams.

1. **Berkshire: Natural Area 66, London Basin**

   Windsor Great Park SSSI and adjacent areas - parkland, U4.

2. **Cornwall and Devon: Natural Areas 91 and 95, South Devon and Cornish Killas and Granites**

   Cliff tops on the south coast of Cornwall and Devon - U1f.

3. **Dorset: Natural Area 80, South Wessex Downs**

   North Poorton - enclosed pasture - U4.

4. **Gloucestershire: Natural Area 61, Dean Plateau and Wye Valley**

   May Hill SSSI - large enclosures, pasture - U1e.

5. **Hampshire: Natural Area 77, New Forest**

   The New Forest SSSI and surrounding areas

   a. Bolton's Bench - settlement-edge green U1f.

   b. Yew Tree Heath, Dibden Enclosure Grazing Strip, Gurnetfields Furzebrake - disturbed and re-seeded areas - U1d.

   c. Blackheath, Bistern Warren, Kingstone Common - grassland on free-draining sand - U1b.

   d. West of Gurnetfields Furzebrake - grass heath - U3.

   e. New Forest site - species-rich bracken - U20a.

6. **Hampshire: Natural Area 70, Wealden Greensand**

   Woolmer Forest area - disturbed heathland edge - U1.

7. **Hereford and Worcester: Natural Area 43, Midlands Plateau**

   Hurcott Pasture SSSI - enclosed pasture - U1f.

8. **Humberside: Natural Area 34, North Lincolnsire Coversands and Clay Vales**

   a. Risby Warren SSSI - grass heath - U1c.

   b. Manton Warren and Twigmoor SSSI and adjacent areas - grass heath, stabilised sand dune, arable reversion - U1, SD11b, H11a.

9. Kent and Sussex (East): Natural Area 71, Romney Marshes

Dungeness SSSI - non-maritime grassland on shingle - U1a.

10. Kent: Natural Area 70, Wealden Greensand

Hatch Park SSSI - parkland - U1.

11. Suffolk: Natural Area 46, Breckland

Lakenheath Warren SSSI - heathland - U2a, SD10b.

12. Sussex (East): Natural Area 74, South Downs

Burnthouse Down West, Clayton to Offham Escarpment SSSI - acid grassland on drift over chalk - U4b.

The abundance of species in community lists is expressed using the DAFOR scale (Dominant, Abundant, Frequent, Occasional, Rare). The abdundance of species in quadrats is expressed using the Domin scale:

1 = few individuals
2 = several individuals
3 = many individuals
4 = 4-10%
5 = 11-25%
6 = 26-33%
7 = 34-50%
8 = 51-75%
9 = 76-90%
10 = 91-100%

1. Berkshire: National Area 66, London Basin

Windsor Great Park SSSI (SU97) and adjacent areas - parkland - U4

Windsor Great Park includes patches of mown acid grassland amongst more improved grasslands. Festuca-Agrostis-Galium Grassland (U4a & b) dominates but locally grades to Deschampsia flexuosa Grassland (U2), Agrostis-Rumex Grassland (U1) and wetter grassland with *Molinia* (M25b). The acid grassland itself grades to neutral grassland. The unimproved grasslands in Windsor Great Park have good 'wax cap' grassland fungi floras and important mycorrhizal fungi assemblages associated with ancient trees. Only one lowland acid grassland indicator species was recorded from the site (*Aira praecox*).

Windsor Great Park SSSI
Quadrats of U4a and U4b
G Steven 6 & 7/7/1995, English Nature

Species	U4a	U4a	U4a	U4b
	SH7	**SH10**	**PH3**	**SH9**
Agrostis capillaris	3	7	4	4
Pseudoscleropodium purum	4	4		4
Festuca ovina	5		6	4
Festuca rubra		8	4	5
Luzula campestris	3	2	4	3
Pilosella officinarum	6		6	4
Potentilla erecta	3	4	2	4
Anthoxanthum odoratum	3			5
Calluna vulgaris	5		6	
Conopodium majus	2	3		2
Danthonia decumbens	5		3	3
Galium saxatile	2		4	
Holcus lanatus		4	2	2
Rumex acetosa		3		1
Stellaria graminea	1	2		2
Carex pilulifera				1
Deschampsia flexuosa	2			
Dicranum scoparium	2			
Hypochaeris radicata	3			3
Nardus stricta	2		3	
Cerastium fontanum				1
Hypnum cupressiforme agg			4	
Plantago lanceolata				5
Tragopogon pratensis				1
Trifolium repens				3
Veronica officinalis				3
Total Number of Species	**16**	**9**	**12**	**20**

SH = Snow Hill
PH = Primrose Hill

2. Cornwall & Devon: Natural Areas 91 and 95, South Devon and Cornish Killas and Granites

Cliff top grassland, Festuca-Agrostis-Rumex grassland Hypochaeris sub-community - Ulf

The samples given in the table below were collected during a survey along the south coast of Cornwall and Devon of the nationally rare *Lotus angustissimus* by Leach *et al* (1994). This explains the constancy V for this species. The sub-community represents an extreme type of U1f where even *Festuca rubra* is rare, *Festuca filiformis* is absent and *Vulpia bromoides* is the predominant grass. It should be contrasted with the much more heathy type of U1f sampled from Boltons Bench in the New Forest (5a). The coastal sub-community occurs generally as small areas on thin droughty soils, often around rock outcrops or as narrow strips alongside paths. Lack of grazing and scrub invasion are likely to have led to loss of this habitat in Cornwall and Devon.

Constancy table for U1f with Lotus angustissimus (from Leach *et al*, 1994)

Species	Constancy
Lotus angustissimus @ **	V(1-7)
Agrostis capillaris	V (2-8)
Vulpia bromoides	V (2-6)
Dactylis glomerata	V (1-6)
Holcus lanatus	IV (2-5)
Plantago coronopus @	IV (2-5)
Crepis capillaris	IV (2-4)
Hypochaeris radicata	IV (1-5)
Trifolium dubium	IV (1-3)
Aira caryophyllea @	III (2-4)
Sedum anglicum @	III (2-4)
Rumex acetosella	III (2-3)
Plantago lanceolata	III (1-9)
Bellis perennis	III (1-6)
Lotus subbiflorus @ *	III (1-6)
Trifolium repens	III (1-5)
Lolium perenne	III (1-4)
Bromus hordeaceus	III (1-3)
Anagallis arvensis	III (1-3)
Sherardia arvensis @	III (1-3)
Teucrium scorodonia	III (1-3)
Vicia sativa	III (1-3)
Sonchus asper	III (1-2)
Senecio jacobaea	II (2-4)
Convolvulus arvensis	II (2-3)
Ornithopus perpusillus @	II (2-3)
Leontodon saxatilis	II (1-5)
Prunella vulgaris	II (1-4)
Cirsium arvense	II (1-3)
Erodium moschatum @ *	II (1-3)
Jasione montana @	II (1-3)
Sagina procumbens	II (1-3)
Trifolium striatum @	II (1-3)
Trifolium campestre	II (1-3)

Species	Constancy
Centaurium erythraea	II (1-2)
Cerastium fontanum	II (1-2)
Hypericum humifusum	II (1-2)
Pteridium aquilinum	II (1-2)
Rubus fruticosus	II (1-2)
Ulex europaeus	II (1)
Carduus nutans	II (1)
Digitalis purpurea	II (1)
Geranium molle	II (1)
Sagina apetala	II (1)
Glechoma hederacea	I (4)
Cynosurus cristatus	I (3)
Festuca rubra	I (3)
Arenaria serpyllifolia	I (3)
Galium mollugo	I (3)
Plantago major	I (3)
Potentilla anglica	I (3)
Potentilla erecta	I (3)
Ranunculus repens	I (3)
Pilosella officinarum	I (2-4)
Poa annua	I (2-3)
Brachypodium sylvaticum	I (2)
Carlina vulgaris	I (2)
Daucus carota	I (2)
Euphrasia sp	I (2)
Galium saxatile	I (2)
Polygala vulgaris	I (2)
Polygonum aviculare	I (2)
Potentilla reptans	I (2)
Rumex acetosa	I (2)
Trifolium arvense @	I (2)
Lotus corniculatus	I (1-3)
Geranium dissectum	I (1-2)
Potentilla sterilis	I (1-2)
Aira praecox @	I (1)
Anthoxanthum odoratum	I (1)

Species	Constancy
Achillea millefolium	I (1)
Cirsium vulgare	I (1)
Erodium cicutarium @	I (1)
Erodium maritimum @	I (1)
Galium verum	I (1)
Geranium columbinum	I (1)
Linum catharticum	I (1)
*Medicago polymorpha @ **	I (1)
Myosotis discolor	I (1)
Ononis repens	I (1)
Picris echioides	I (1)
Sanguisorba minor	I (1)
Sonchus oleraceus	I (1)
Taraxacum sp.	I (1)
Torilis japonica	I (1)
*Trifolium glomeratum @ **	I (1)
Trifolium pratense	I (1)
Trifolium scabrum @	I (1)
Trifolium subterraneum @	I (1)
Veronica chamaedrys	I (1)
Veronica serpyllifolia	I (1)

Number of samples	14
Total number taxa	91
Mean number taxa/sample	25
Range of species number	14-40
Number acid grassland indicators (@)	18
Number nationally scarce (*)	1
Number nationally rare (**)	4

Two other acid grassland indicators, *Moenchia erecta*, and *Trifolium ornithopodioides* also occur in the sub-community (S Leach pers.comm.)

3. Dorset: Natural Area 80, South Wessex Downs

North Poorton (SY59) - enclosed pasture - U4

The site was surveyed by Ron Porley, English Nature, in 1990 (Porley 1992). The area includes a well developed stand of moist acid grassland (Festuca-Agrostis-Galium Grassland U4) on a north-facing slope in western Dorset, a region with a low moisture deficit. The underlying soils are well-draining and overly Jurassic sands. The stand includes frequent anthills which have a U1-type of vegetation, hence the records of species such as *Rumex acetosella* and *Aira praecox* in the constancy table. The main sward is, however, a good example of U4a for a lowland situation, although the abundance of *Leontodon autumnalis* is atypical of U4 in general. Only one lowland acid grassland indicator species was recorded from the site (*Aira praecox*). There is a well-developed bryophyte layer, with *Rhytidiadelphus squarrosus* dominating, and variable amounts of *Pseudoscleropodium purum*, *Dicranum scoparium* and *Hylocomium splendens*. The site is grazed by sheep, cattle and rabbits.

North Poorton
Constancy table for U4a with U1a on Anthills
R Porley 6/9/1990, English Nature

Species	Q1	Q2	Q3	Q4	Q6	Constancy
Achillea millefolium	2	5	4	2	2	V
Agrostis capillaris	5	7	8	8	8	V
Anthoxanthum odoratum	3	4	2	3	4	V
Galium saxatile	8	8	8	7	8	V
Leontodon autumnalis	3	4	2	2	6	V
Luzula campestris	3	3	3	3	3	V
Potentilla erecta	4	3	4	4	6	V
Rseudoscleropodium purum	4	3	3	4	2	V
Rhytidiadelphus squarrosus	8	6	8	8	8	V
Festuca ovina	8	8	8	6		IV
Rumex acetosa		2	4	2	4	IV
Dicranum scoparium	2	2		2		III
Holcus lanatus		3		2	2	III
Hypochaeris radicata		1	3		3	III
Peltigera sp	1	1	2			III
Rumex acetosella	6			4	2	III
Veronica officinalis	2		4	3		III
Aira praecox			1	2		II
Lophocolea bidentata			1		1	II
Polytrichum formosum	2	1				II
Viola riviniana		3	2			II
Atrichum undulatum			2			I
Cirsium palustre		1				I
Festuca rubra					5	I
Hylocomium splendens	2					I
Hypnum cupressiforme agg			1			I
Plagiomnium affine					1	I
Plantago lanceolata		1				I
Polygala vulgaris	2					I
Ranunculus acris		2				I
Veronica chamaedrys		2				I
Total Number of Species	**17**	**21**	**19**	**16**	**16**	**Mean = 17.8**
Sward Height, cm.	**2-4**	**2-4**	**2-4**	**2-4**	**4-6**	

4. Gloucestershire: Natural Area 61, Dean Plateau and Wye Valley

May Hill SSSI (SO 6921) - large enclosure, pasture - U1e

May Hill SSSI is an area of acid grassland on the summit of an isolated Silurian sandstone hill, north-east of the Forest of Dean at 235-300m in height. It is an upland fringe site in character. It is owned by the National Trust and was surveyed by Gloucestershire Wildlife Management Ltd for EN in 1995. The predominant community is a species-poor U1c community but there are also areas of M6 mire and rush pasture (M23b). The extensive nature of the acid grassland is a rare feature in Gloucestershire. The community species list and a constancy table of the four U1c quadrats recorded is given below. Bryophytes were not recorded and $1m^2$ quadrats used rather than $4m^2$ quadrats. The grassland is heavily sheep-grazed and rabbit grazing is locally significant. Some management of gorse and bracken by flailing is carried out.

May Hill SSSI,
U1e: Community species list
Date of survey: 5/6/95

Species	DAFOR
Trees & tall shrubs	
Betula pendula	R
Crataegus monogyna	R
Quercus robur	R
Dwarf shrubs	
Ulex gallii	O
Grasses	
Agrostis capillaris	F
Aira praecox @	R
Anthoxanthum odoratum	F
Danthonia decumbens	R
Deschampsia cespitosa	R
Deschampsia flexuosa	O
Festuca ovina agg	F
Festuca rubra	R
Nardus stricta	R
Holcus lanatus	F
Poa annua	R
Poa pratensis	O
Other vascular plants	
Carex echinata	R
Carex ovalis	R
Carex pilulifera	R
Carex viridula oedocarpa	R
Cerastium fontanum	R
Cirsium palustre	R
Cirsium vulgare	R
Conopodium majus	R
Digitalis purpurea	R
Galium saxatile	F
Hyacinthoides non-scripta	R
Juncus articulatus	R
Juncus compressus	R
Leontodon hispidus	R
Lotus corniculatus	R
Luzula campestris	F
Pilosella officinarum	R
Plantago lanceolata	R
Polygala serpyllifolia	R
Potentilla erecta	O
Pteridium aquilinum	O
Ranunculus bulbosus	R
Rumex acetosa	R
Rumex acetosella	F
Sagina procumbens	R
Stellaria graminea	R
Taraxacum sp.	R
Teucrium scorodonia	R
Trifolium repens	R
Ulex gallii	R
Urtica dioica	R
Veronica chamaedrys	R
Veronica officinalis	O
Viola riviniana	R

Total number of species = 49
Number of acid grassland indicator species (@) = 1

May Hill SSSI
U1e: Constancy table
Date of survey: 5/6/95

Species	Q1	Q2	Q3	Q4	Constancy
Agrostis capillaris	5	5	5	6	IV
Anthoxanthum odoratum	5	5	5	5	IV
Festuca ovina agg	5	7	6	5	IV
Galium saxatile	7	5	5	5	IV
Holcus lanatus	4	3	1	5	IV
Luzula campestris	5	5	4	1	IV
Rumex acetosella	4	4	2	5	IV
Potentilla erecta		1	2	4	III
Deschampsia flexuosa	4			4	II
Pteridium aquilinum		1		4	I
Leontodon hispidus			2		I
Lotus corniculatus			4		I
Pilosella officinarum			4		I
Poa pratensis		1			I
Polygala serpyllifolia				2	I
Taraxacum sp			3		I
Teucrium scorodonia				1	I
Trifolium repens		1			I
Ulex gallii			4		I
Veronica officinalis			2		
Species total	**8**	**11**	**14**	**12**	**11.25 (mean)**

5. Hampshire: Natural Area 77, New Forest

The New Forest SSSI and surrounding areas

Acid grassland forms an integral part of the New Forest heathlands, and covers more than 2000 ha. Examples of the main types found are given below. Most are grazed within the extensive pastoral system of the New Forest. The main types of dry acid grassland were sampled by the contractor in 1997 and selected examples are presented below, along with some quadrat data collected during an NCC survey of river terraces west of the New Forest proper.

a. Boltons Bench (SU3008) - settlement-edge green - U1f

This site consists of about 13.5ha of Festuca-Agrostis-Rumex Grassland Hypochaeris sub-community (U1f) on an ancient village green, east of Lyndhurst. The green has been locally disturbed by past sand digging and by war-time installations. A constancy table and a community list for UIf are given below. The variable U1f here is typical of the range of vegetation referable to U1f in the New Forest. *Danthonia* is frequent throughout while *Nardus* occurs locally. This is very typical of New Forest stands and the samples range from very dry stands on higher ground to mesic stands at the base of slopes. *Chamaemelum nobile* is very characteristic of the latter stands. Within the acid grassland are patches of Gorse scrub, much of which has been recently burned or cut.

Away from the village the U1f grassland is replaced by Bracken (U20a) to the east, and by heath (H2c with patches of H3a) to the north-east. There is an ephemeral pond with vegetation referable to MG13, with the RDB species *Galium constrictum* in the lowest part.The ephemeral pond with vegetation supports Fairy Shrimps when it remains wet for long enough in summer.

A total of 77 species were recorded from the U1f, of which 16 are dry acid grassland indicator species and one, *Chamaemelum nobile*, is a nationally scarce species. Some species, such as *Cerastium diffusum*, *Filago minima*, and the nationally declining *Sagina subulata*, were noticeably restricted to areas disturbed by sand digging, war-time buildings and anti-car ditches by the roads.

The sward height is reduced to less than 1cm by heavy pony and cattle grazing, and lower plants are very prominent. The grassland attracts free-ranging animals and the green is the centre of several pony herd home ranges as well as receiving regular attention from a cattle herd (in spite of the shortness of the sward). Within the acid grassland the Gorse is managed by burning and cutting on a long rotation, this is because of slow regrowth after winter browsing. The green is a major honey-pot site for tourists and part is a cricket pitch resulting in local areas being trampled into a very species-poor *Agrostis capillaris* sward.

Boltons Bench, New Forest
U1f community list (NA Sanderson 26/5/97, EPR)

Species	DAFOR
Trees & tall shrubs	
Ulex europaeus	F
Dwarf shrubs	
Calluna vulgaris	O
Erica cinerea	O
Ulex minor @	R
Grasses	
Agrostis capillaris	D
Agrostis curtisii	O
Aira praecox @	A
Anthoxanthum odoratum	O
Danthonia decumbens	F
Festuca filiformis	F
Festuca rubra	F
Holcus lanatus	R
Molinia caerulea	R
Nardus stricta	O
Poa annua	F
Poa pratensis	O
Vulpia bromoides	A
Other vascular plants	
Achillea millefolium	O
Aphanes inexspectata @	F
Bellis perennis	O
Carex caryophyllea	O
Carex hirta	R
Carex pilulifera	O
Cerastium diffusum @	F
Cerastium fontanum	O
Cerastium semidecandrum @	O
*Chamaemelum nobile * @*	F
Coronopus dydimus	O
Erophila verna	O
Filago minima @	O
Galium saxatile	R
Geranium molle	R
Hypochaeris radicata	A
Juncus bufonius	O
Juncus squarrosus	R
Leontodon saxatilis	F
Lotus corniculatus	O
Luzula campestris	O

Species	DAFOR
Moenchia erecta @	F
Montia fontana minor	O
Ornithopus perpusillus @	F
Pilosella officinarum	F
Plantago coronopus @	A
Plantago lanceolata	O
Potentilla erecta	O
Prunella vulgaris	R
Ranunculus bulbosus	O
Ranunculus repens	R
Rubus fruticosus	O
Rumex acetosella	A
Sagina apetala	O
Sagina procumbens	F
Sagina subulata @	O
Senecio jacobaea	O
Senecio sylvaticus	O
Spergularia rubra @	O
Taraxacum sect Erythrosperma	O
Trifolium dubium	O
Trifolium micranthum	F
Trifolium ornithopodioides @	F
Trifolium repens	O
Trifolium striatum @	R
Veronica arvensis	O
Veronica officinalis	O
Veronica serpyllifolia	R
Mosses	
Brachythecium albicans	O
Campylopus introflexus	O
Ceratodon purpureus	O
Dicranum scoparium	F
Hypnum lacunosum tectorum @	A
Hypnum jutlandicum	O
Polytrichum juniperinum	A
Racomitrium elongatum @	O
Rhytidiadelphus squarrosus	O
Lichens	
Cladonia furcata	O
Coelocaulon aculeatum @	R
Placynthiella icmalea	R

Total number of species = 77
Number of nationally scarce species (*) = 1
Number of acid grassland indicator species (@) = 17

Boltons Bench, New Forest
Constancy table for U1f (N A Sanderson 26/5/97, EPR)

Species	Q1	Q2	Q3	Q4	Q5	Constancy
Agrostis capillaris	5	5	7	8	5	V
Danthonia decumbens	5	4	1	1	4	V
Hypnum lacunosum tectorum	8	5	4	6	3	V
Hypochaeris radicata	5	6	4	3	4	V
Rumex acetosella	3	3	3	3	3	V
Vulpia bromoides	4	6	5	5	3	V
Aira praecox		4	3	4	3	IV
Ornithopus perpusillus	2	4		2	1	IV
Plantago coronopus		2	4	3	3	IV
Polytrichum juniperinum	3	3	1	3		IV
Rhytidiadelphus squarrosus		3	1	3	4	IV
Chamaemelum nobile	4	2			6	III
Festuca rubra		3		5	6	III
Pilosella officinarum		2		2	6	III
Poa annua		2	2	3		III
Bellis perennis				3	3	II
Festuca filiformis	4		6			II
Leontodon saxatilis			2	2		II
Luzula campestris				1	2	II
Plantago lanceolata				3	3	II
Poa pratensis				1	3	II
Sagina procumbens		2		2		II
Trifolium micranthum				3	3	II
Trifolium ornithopodioides			3	3		II
Achillea millefolium	2					I
Brachythecium albicans			4			I
Calluna vulgaris		1				I
Carex caryophyllea					5	I
Cerastium diffusum		1				I
Cerastium semidecandrum				3		I
Cladonia furcata	1					I
Coelocaulon aculeatum			1			I
Dicranum scoparium		3				I
Filago minima			2			I
Geranium molle				2		I
Holcus lanatus					3	I
Moenchia erecta		1				I
Montia fontana minor		2				I
Nardus stricta		3				I
Sagina subulata			3			I
Taraxacum sect Erythrosperma				1		I
Trifolium repens		2				I
Bare soil	**3**	**3**	**4**	**3**	**2**	
Species total	**12**	**23**	**19**	**24**	**30**	**Mean = 19.6**

b. Yew Tree Heath, Dibden Inclosure Grazing Strip, Gurnetfields Furzebrake - disturbed and re-seeded areas - U1d

A distinctive vegetation has developed on heathland disturbed by the construction of military installations during World War Two, arable cultivation in the 1940's and 50's, or by re-seeding and liming in the 1960's. A constancy table is presented for quadrats collected from the three sites and a community list from one site, Yew Tree Heath (SU3606), given below.

Dibden Inclosure Grazing Strip (SU4006) consists of 10ha of grassland (U1d/f) and herb-rich heath (transitions between U1d/f and H2) which originated from H2c and H3c heathland ploughed and re-seeded in the early 1960's. A total of 81 species were recorded including 16 lowland dry acid grassland indicator species and one nationally scarce species (*Viola lactea*).

Gurnetfields Furzebrake, Culverley (SU3704) is one of the areas of heathland, which were probably originally H2, H3 and Gorse scrub, that was ploughed up and put under arable cultivation in the 1940's and 1950's and then reseeded. U1d/f is the main community, ericaceous species have colonised but nowhere dominate. The site covers 30ha and within this area 70 species were recorded, of which 12 species were indicator species and one was a nationally scarce species (*Chamaemelum nobile*).

Yew Tree Heath (SU3606) was also much affected by military construction during World War Two, so the grassland cannot be older than 50 years. Substrates include much broken concrete, mixed with plateau gravel, and mounds of mixed material occur across the site. The vegetation consists of a mosaic of parched acid grassland, herb-rich dry heath and Gorse scrub, grading into H2 and H3 heathland. The parched acid grassland is a typical New Forest mix of U1d and U1f species. Where *Calluna* has grown into a taller sward a very curious type of heath has developed. This herb-rich heath is typical of heath recolonising disturbed soils on the New Forest. It would probably be best described as a *Danthonia* sub-community of H2 but it appears that no herb-rich heath was sampled in southern England during the preparation of the NVC.

Yew Tree Heath is remarkably species-rich with 103 species recorded in 1997, of which 24 were dry acid grassland indicator species, and 2 were nationally scarce species, *Vulpia ciliata ambigua* and *Viola lactea*. A characteristic feature is the presence of several lime-loving species such as *Clinopodium acinos*, *Carlina vulgaris*, *Cirsium acaule* and *Linum catharticum*. The sward height has been reduced to less than 1cm by heavy pony and cattle grazing and lower plants are very prominent in the grassland. The Heather in the herb-rich heath areas is not being significantly grazed.

New Forest
Constancy table for U1d/f & Transition to H2 (N A Sanderson 5/1997, EPR)

	U1d/f	U1d/f	U1d/f	U1d/f	U1/H2	U1/H2	
Species	YTH1	DGS2	GF1	GF2	DGS1	YTH2	Constancy
Agrostis capillaris	5	5	5	5	4	2	V
Aira praecox	3	3	2	3	3	2	V
Calluna vulgaris	3	1	1	3	6	8	V
Danthonia decumbens	1	7	8	8	7	6	V
Erica cinerea	2	3		2	4	4	V
Festuca rubra	3	2	2	3		1	V
Hypochaeris radicata	4	3	4	4	4	3	V
Leontodon saxatilis	2	3	3	3	3		V
Lotus corniculatus	6	5	3	6	4	5	V
Pilosella officinarum	5	3	3	6	4	5	V
Plantago lanceolata	3	4	2	3	2	3	V
Vulpia bromoides	4	3	3	3	3	2	V
Centaurium erythraea	3	3		3	2		IV
Plantago coronopus	6	2	4	2			IV
Poa pratensis	1	2	1			1	IV
Polytrichum juniperinum	3	4	3		3		IV
Taraxacum sect Erythrosperma	1	1	2	2	1		IV
Bellis perennis	2	2			2		III
Campylopus introflexus			3		2	1	III
Carex caryophyllea			3	2		2	III
Cladonia furcata	2	1			4		III

	U1d/f	U1d/f	U1d/f	U1d/f	U1/H2	U1/H2	
Species	YTH1	DGS2	GF1	GF2	DGS1	YTH2	Constancy
Euphrasia nemorosa	2		3		2		III
Hypnum lacunosum tectorum	3		3	3			III
Linum catharticum	2	3			3		III
Polygala serpyllifolia			1	3		2	III
Rumex acetosella	2	2	2				III
Trifolium striatum	3		2	2			III
Ulex minor		5			4	4	III
Achillea millefolium	2					2	II
Aira caryophyllea	3					2	II
Anthoxanthum odoratum		3			2		II
Cladonia chlorophea	2		2				II
Luzula campestris				1	4		II
Rhytidiadelphus squarrosus			2	2			II
Sagina procumbens		2	3				II
Trifolium micranthum	3		2				II
Viola riviniana					1	2	II
Aphanes inexspectata			1				I
Atrichum undulatum	2						I
Cerastium fontanum					1		I
Ceratodon purpureus	5						I
Cladonia foliacea	3						I
Cladonia pyxidata	2						I
Cladonia rangiformis					2		I
Dactylis glomerata		1					I
Dicranum scoparium		3					I
Festuca filiformis						4	I
Holcus lanatus					1		I
Hypnum jutlandicum						3	I
Luzula multiflora						2	I
Molinia caerulea					3		I
Ornithopus perpusillus			2				I
Pedicularis sylvatica						3	I
Peltigera polydactyla						1	I
Polytrichum piliferum	2						I
Potentilla erecta						3	I
Prunella vulgaris			1				I
Pseudoscleropodium purum					5		I
Radiola linoides			3				I
Ranunculus bulbosus						1	I
Rubus fruticosus						1	I
Sagina apetala	2						I
Scleropodium tourettii	2						I
Senecio jacobaea					1		I
Trifolium dubium				2			I
Trifolium pratense		1					I
Veronica officinalis					3		I
Viola canina						2	I
Species total	**35**	**27**	**30**	**22**	**30**	**28**	**Mean = 34.4**

U1/H2 = U1d/f/H2   YTH = Yew Tree heath   DG = Dibden Grazing strip   GF = Gurnetfields Furzebrake, Culverley

New Forest, Yew Tree Heath
U1d & U1d/H2 Community
Date of survey: 1/6/97 & 26/7/97

Species	DAFOR
Dwarf shrubs	
Calluna vulgaris	F
Erica cinerea	F
Ulex europaeus	F
Ulex minor @	O
Grasses	
Agrostis capillaris	A
Agrostis curtisii	O
Aira caryophyllea @	A
Aira praecox @	A
Catapodium rigidum	R
Cynosurus cristatus	R
Dactylis glomerata	R
Danthonia decumbens	F
Festuca filiformis	O
Festuca rubra	F
Holcus lanatus	R
Molinia caerulea	R
Poa annua	O
Poa pratensis	O
Vulpia bromoides	A
*Vulpia ciliata ambigua * @*	O
Other vascular plants	
Achillea millefolium	F
Anagallis arvensis	O
Aphanes inexspectata @	F
Arenaria serpyllifolia	R
Bellis perennis	O
Carex caryophyllea	O
Carex flacca	R
Carex panicea	R
Carex pilulifera	F
Centaurium erythraea	F
Cerastium fontanum	R
Cerastium glomeratum	R
Carlina vulgaris	R
Cerastium diffusum @	O
Cerastium semidecandrum @	O
Cirsium acaule	R
Clinopodium acinos	R
Cuscuta epithymum	R
Erigeron acer @	O
Erodium cicutarium @	R

Species	DAFOR
Luzula multiflora	R
Medicago lupulina	R
Moenchia erecta @	O
Ornithopus perpusillus @	F
Pedicularis sylvatica	O
Pilosella officinarum	A
Plantago coronopus @	A
Plantago lanceolata	F
Polygala serpyllifolia	O
Potentilla erecta	O
Potentilla reptans	R
Prunella vulgaris	O
Ranunculus bulbosus	O
Rubus fruticosus	R
Rumex acetosella	A
Sagina apetala	F
Sagina procumbens	O
Sagina subulata @	O
Senecio jacobaea	O
Taraxacum sect Erythrosperma	O
Teucrium scorodonia	O
Trifolium dubium	R
Trifolium micranthum	F
Trifolium ornithopodioides @	O
Trifolium pratense	O
Trifolium repens	R
Trifolium striatum @	F
Veronica arvensis	O
Veronica officinalis	O
Viola canina @	F
*Viola lactea * @*	R
Viola riviniana	O
Mosses	
Atrichum undulatum	R
Brachythecium albicans	O
Campylopus introflexus	O
Ceratodon purpureus	A
Dicranum scoparium	R
Hypnum jutlandicum	O
Hypnum lacunosum tectorum @	F
Polytrichum juniperinum	F
Polytrichum piliferum	F
Scleropodium tourettii @	O

Species	DAFOR
Euphrasia nemorosa	F
Filago minima @	F
Fragaria vesca	O
Galium saxatile	O
Hypericum humifusum	R
Hypericum pulchrum	R
Hypochaeris radicata	F
Leontodon saxatilis	F
Linum catharticum	F
Lotus corniculatus	A
Luzula campestris	O

Species	DAFOR
Lichens	
Cladonia c. cervicornis	O
Cladonia chlorophea	O
Cladonia foliacea @	O
Cladonia furcata	F
Cladonia portentosa	R
Cladonia pyxidata	O
Cladonia rangiformis	F
Cladonia uncialis @	O
Coelocaulon aculeatum @	O
Peltigera polydactyla	O

Total number of species = 103
Number of nationally scarce species (*) = 2
Number of acid grassland indicator species (@) = 24

c. Blackheath, Bistern Warren, Kingstone Common - grassland on freely-draining sand- U1b

In the western part of the New Forest and on sand terraces on the edge of the flood plain of the River Avon in Hampshire, the U1f grassland characteristic of the winter-wet soils typical of most of the Forest is locally replaced by Festuca-Agrostis-Rumex Grassland typical sub-community (U1b). Six example quadrats from three sites, one in the New Forest and two on the Avon sand terraces were used to construct the constancy table shown below, and a community list for Blackheath is also given.

The acid grassland of Blackheath in the New Forest (SU1810) is on an ancient settlement-edge, green, which lies over unusually free-draining sand. The area surveyed is one of a number of species-rich U1b grasslands found in this area of the New Forest and it lacks many of the typical species of New Forest U1f stands. The grassland ranges from rather herb-poor areas dominated by bryophytes to patches of much richer vegetation. The sward height is reduced to less than 1cm by heavy pony and cattle grazing.

A total of 75 species were recorded from the U1b grasland in 1997, including 18 dry acid grassland indicator species and 3 nationally scarce species (*Crassula tillaea, Hypochaeris glabra* and *Peltigera canina*). Two other indicators had been recorded previously by Brewis et al (1996). The *Crassula tillaea* was originally found here as a few plants in 1990 but by 1997 had become abundant and spread widely, presumably in response to the recent dry summers. This site is the only known locality in the New Forest for *Hypochaeris glabra* and *Cerastium arvense.*

Bistern Warren lies on a river terrace (SU1400) of the River Avon. It is an interesting, privately owned site. It was formerly a rabbit warren and is now grazed by cattle and wild rabbits. The surviving acid grassland on the sand terrace has remained uncultivated because the presence of stabilised dunes and a large blow out have created uneven terrain. The blow out is bowl-shaped and in places has been eroded to the level of the modern flood plain, creating areas of wet heath and damp grassland (M16 & M25b). The slopes of the old dunes and the blow out carry U1b stands, with *Carex arenaria* occuring locally.

Kingstone Common (SU1403) lies on a sand terrace north of Bistern Warren. The Common includes important ephemeral pond communities and much acid grassland. *Galium saxatile* is more frequent here than the above sites producing a grassland type with elements of U1e. The site was ungrazed when surveyed in 1989 but has been subsequently grazed by ponies.

New Forest Area
Constancy Table for U1b & U1b/U1e
N A Sanderson 5/1997, EPR & N A Sanderson 4/1989, NCC

Species	BH3	BH1	BW1	BW4	KC4	Constancy
Agrostis capillaris	4	5	8	7	5	V
Rumex acetosella	8	3	2	4	4	V
Aira praecox	5	4		4	2	IV
Dicranum scoparium	4	3		4	2	IV
Hypnum lacunosum tectorum	6	5		4	2	IV
Luzula campestris	2		6	3	4	IV
Brachythecium albicans		6	7	7		III
Calluna vulgaris	1			3	3	III
Holcus lanatus			4	3	1	III
Polytrichum juniperinum	7	3		3		III
Rhytidiadelphus squarrosus		5	1	2		III
Veronica arvensis	2	2			1	III
Anthoxanthum odoratum			2		2	II
Aphanes inexspectata	2	2				II
Carex arenaria				4	4	II
Cladonia furcata	1			3		II
Ornithopus perpusillus	3	3				II
Plantago coronopus	2	4				II
Poa annua	3		2			II
Pteridium aquilinum	2	2				II
Vulpia bromoides	4	6				II
Brachythecium rutabulum			1			I
Cerastium fontanum			2			I
Cerastium semidecandrum	1					I
Cladonia rangiformis	1					I
Crassula tillaea	3					I
Erodium cicutarium		4				I
Festuca filiformis					7	I
Galium saxatile					4	I
Hypochaeris glabra		3				I
Moenchia erecta		3				I
Peltigera canina		4				I
Poa pratensis			4			I
Pseudoscleropodium purum					5	I
Senecio jacobaea		1				I
Stellaria graminea					3	I
Taraxacum sect Erythrosperma		1				I
Trifolium ornithopodioides		2				I
Trifolium repens			3			I
Trifolium striatum		4				I
Ulex minor					3	I
Urtica urens				1		I
Species total	**19**	**22**	**12**	**14**	**16**	**Mean = 16.6**

BH = Blackheath, New Forest (SU1810) (U1b)
BW = Bistern Warren, Avon River Terrace (SU1400) (U1b)
KC = Kingstone Common, Avon River Terrace (SU1403) (U1b/U1e)

New Forest, Blackheath
U1b Community
Date of survey: 24/5/97 & 11/6/97

Species	DAFOR
Dwarf shrubs	
Calluna vulgaris	O
Erica tetralix	R
Grasses	
Agrostis capillaris	A
Aira praecox @	A
Anthoxanthum odoratum	R
Bromus hordeaceus	R
Danthonia decumbens	O
Deschampsia flexuosa	O
Festuca rubra	R
Holcus mollis	R
Molinia caerulea	R
Poa annua	F
Poa pratensis	O
Vulpia bromoides	A
Other vascular plants	
Achillea millefolium	O
Aphanes inexspectata @	F
Arctium minus	R
Bellis perennis	R
Carex panicea	R
Cerastium diffusum @	R
Cerastium fontanum	R
Cerastium glomeratum	R
Cerastium semidecandrum @	O
*Crassula tillaea * @*	O
Erodium cicutarium @	R
Galium saxatile	O
Hypericum humifusum	R
*Hypochaeris glabra * @*	O
Hypochaeris radicata	O
Juncus bufonius	O
Luzula campestris	F
Malva moschata	R
Moenchia erecta @	O
Ornithopus perpusillus @	F
Pilosella officinarum	O
Plantago coronopus @	F
Plantago lanceolata	R

Species	DAFOR
Potentilla erecta	O
Prunella vulgaris	R
Pteridium aquilinum	F
Ranunculus bulbosus	R
Rumex acetosella	A
Sagina procumbens	O
Senecio jacobaea	R
Spergularia rubra @	O
Stellaria graminea	R
Stellaria media	R
Taraxacum sect Erythrosperma	O
Trifolium dubium	R
Trifolium micranthum	O
Trifolium ornithopodioides @	R
Trifolium striatum @	R
Urtica dioica	R
Veronica arvensis	O
Veronica chamaedrys	R
Veronica officinalis	R
Veronica serpyllifolia	R
Mosses	
Brachythecium albicans	O
Campylopus introflexus	O
Ceratodon purpureus	O
Dicranum scoparium	F
Hypnum jutlandicum	F
Hypnum lacunosum tectorum @	A
Leucobryum glaucum	R
Pleurozium schreberi	O
Polytrichum juniperinum	A
Pseudoscleropodium purum	O
Rhytidiadelphus squarrosus	F
Lichens	
Cladonia arbuscula @	O
Cladonia ciliata @	R
Cladonia furcata	O
Cladonia portentosa	R
Cladonia rangiformis	R
Coelocaulon aculeatum @	R
*Peltigera canina * @*	O

Total number of species = 75
Number of nationally scarce species (*) = 3
Number of acid grassland indicator species (@) = 18

Site Total of Acid Grassland Indicator Species:
Additional indicator species recored previously Brewis et al, (1996):
Cerastium arvense @
Stellaria pallida @
Number of acid grassland indicator species (@) = 20

d. West of Gurnetfields Furzebrake - grass heath - U3

In the New Forest Agrostis curtisii Grassland (U3) is generally associated with acid brown earths, which are inherently somewhat more fertile than the soils under adjacent heaths. The community is found where no recent soil disturbance has occurred, or where there are no heavy concentrations of grazing animals. The U3 stands are invariably less diverse than the U1 grasslands and are much more like *Nardo-Galium* grasslands in character than *Thero-Airion* grasslands. Two quadrats from a surveyed example are given below along with a community species list. The site occurs in an unploughed area west of Gurnetfields Furzebrake (SU3704).

Together with *Agrostis curtisii*, the grasses *Agrostis capillaris*, *Anthoxanthum odoratum*, *Danthonia decumbens* and *Molinia caerulea* are found, with *Aira praecox* in drier areas. Typical widespread herbs include *Galium saxatile*, *Hypochaeris radicata*, *Pedicularis sylvatica*, *Potentilla erecta* and *Polygala serpyllifolia*. Locally an assemblage of *Serratula tinctoria*, *Stachys officinalis* and *Succisa pratensis* occurs.

West of Gurnetfields Furzebrake, Culverley
U3: Community list

N A Sanderson, EPR, Date of survey: 29/5/97

Species	DAFOR
Dwarf shrubs	
Calluna vulgaris	F
Erica cinerea	F
Ulex europaeus	O
Grasses	
Agrostis capillaris	A
Agrostis curtisii	D
Aira praecox @	F
Anthoxanthum odoratum	F
Danthonia decumbens	F
Molinia caerulea	F
Other vascular plants	
Bellis perennis	R
Carex panicea	O
Carex pilulifera	F
Cerastium fontanum	R
Dactylorhiza maculata	R
Euphrasia nemorosa	F
Galium saxatile	F
Hypochaeris radicata	F
Juncus bufonius	R
Leontodon saxatilis	O
Luzula campestris	O
Pedicularis sylvatica	F
Polygala serpyllifolia	F
Potentilla erecta	F
Pteridium aquilinum	O
Rubus fruticosus	O
Rumex acetosella	F
Serratula tinctoria	O
Stachys officinalis	R
Succisa pratensis	O
Teucrium scorodonia	O
Veronica officinalis	O
Viola riviniana	O
Other mosses	
Campylopus pyriformis	O
Dicranum scoparium	O
Hypnum jutlandicum	F
Polytrichum juniperinum	F
Lichens	
Placynthiella icmalea	O

Total number of species = 37
Number acid grassland indicator species (@) = 1

West Of Gurnetfields Furzebrake
U3: Quadrat 3
Date of survey: 29/5/97

Species	Domin
Dwarf shrubs	
Calluna vulgaris	1
Erica cinerea	3
Ulex europaeus	1
Grasses	
Agrostis capillaris	5
Agrostis curtisii	8
Aira praecox	2
Danthonia decumbens	4
Molinia caerulea	3
Other vascular plants	
Carex panicea	3
Carex pilulifera	5
Galium saxatile	3
Hypochaeris radicata	3
Pedicularis sylvatica	2
Polygala serpyllifolia	3
Potentilla erecta	3
Serratula tinctoria	1
Veronica officinalis	1
Mosses	
Campylopus pyriformis	3
Hypnum jutlandicum	2
Lichens	
Placynithiella icmalea	2

Total number of species = 20
Quadrat size = 4m^2
Vegetation height = 0 - 2cm
Management: heavily pony & cattle grazed

West Of Gurnetfields Furzebrake
U3: Quadrat 4
Date of survey: 29/5/97

Species	Domin
Dwarf shrubs	
Calluna vulgaris	2
Erica cinerea	1
Grasses	
Agrostis capillaris	4
Agrostis curtisii	7
Anthoxanthum odoratum	5
Danthonia decumbens	2
Molinia caerulea	4
Other vascular plants	
Carex panicea	3
Carex pilulifera	6
Galium saxatile	2
Hypochaeris radicata	3
Pedicularis sylvatica	2
Polygala serpyllifolia	3
Potentilla erecta	5
Pteridium aquilinum	2
Serratula tinctoria	3
Stachys officinalis	2
Succisa pratensis	2
Veronica officinalis	4

Total number of species = 19
Quadrat size = 4m^2
Vegetation height = 0 - 3cm
Management: heavily pony & cattle grazed

e. New Forest Site (SU30, location withheld) - species-rich bracken - U20a

The site consists of 4.25ha of Bracken-dominated grassland north of an ancient pasture woodland, in the open grazings of the New Forest. A community species list and two quadrats are reproduced below. The sampled area is at the base of a slope and is clearly on reasonably fertile brown earths, similar to those within the woodland but very different from the heath beyond. The junction between the species-rich bracken and the heath is quite sharp. The history of the site is obscure and would require detailed investigation but some relationship with the adjacent pasture woodland is suggested.
The area is variably dominated by Bracken (the fronds were still expanding when the site was visited). The vegetation is species-rich and the dominance of Bracken places it clearly within U20a. However the frequency of *Anemone nemorosa* and *Hyacinthoides non-scripta* indicates a relationship with W10b (the adjacent pasture woodland is a W10b/W11 transition). Other species such as *Serratula tinctoria*, *Stachys officinalis*, *Succisa pratensis*, *Carex montana* and *Lathyrus latifolius* are also characteristic of local W10b woodlands, and these species are in addition found locally in M24c, M16b and MG5c stands. These communities have also probably derived from the clearance or regression of W10b type woodland. Any relation with U4c, at least as defined in the NVC, is quite weak in comparison.

The flora is not as diverse as the richest parched acid grasslands sites. A total of 68 species were recorded and, not unexpectedly there were few dry acid grassland indicators. The vegetation is, however, remarkably rich for a Bracken stand, with the nationally rare *Gladiolus illyricus* and the nationally scarce *Carex montana* present. The former plant is confined to this habitat in Britain and unlike many of the other species of interest has never been recorded inside woodland.

Much of the stand is mown annually in late summer for bracken litter. This is probably too frequent and may be threatening both the *Gladiolus illyricus* population and compromising the potential of the site to support butterflies which feed on violets. Rotational cutting, with no area cut more than once every two or three years, would be more appropriate. The site is heavily grazed by cattle and ponies except in mid-summer when dense Bracken stands are largely avoided by stock.

New Forest SU30

U20a: Community List

Date of survey: 28/5/97

Species	DAFOR
Trees & tall shrubs	
Crataegus monogyna	O
Prunus spinosa	R
Dwarf shrubs	
Calluna vulgaris	O
Erica cinerea	F
Genista anglica	R
Grasses	
Agrostis capillaris	A
Agrostis curtisii	O
Aira praecox @	O
Anthoxanthum odoratum	F
Danthonia decumbens	F
Festuca filiformis	A
Festuca rubra	A
Molinia caerulea	O
Poa pratensis	R
Vulpia bromoides	O
Other vascular plants	
Achillea millefolium	O
Ajuga reptans	O
Anemone nemorosa	F
Bellis perennis	O
Campanula rotundifolia	O
Carex caryophyllea	A
Carex montana * @	F
Carex panicea	O
Centaurium erythraea	O
Cerastium fontanum	R
Conopodium majus	O
Dactylorhiza maculata	O
Euphrasia nemorosa	F
Galium saxatile	O
Gladiolus illyricus ** @	R
Hyacinthoides non-scripta	F
Hypericum pulchrum	O
Hypochaeris radicata	A
Lathyrus latifolius	R
Lonicera periclymenum	O
Lotus corniculatus	F
Luzula campestris	F
Lysimachia nemorum	R
Pedicularis sylvatica	O
Pilosella officinarum	A
Plantago lanceolata	O
Polygala serpyllifolia	O
Potentilla erecta	F
Potentilla sterilis	O
Prunella vulgaris	O
Pteridium aquilinum	D
Rubus fruticosus	R
Sagina procumbens	O
Senecio jacobaea	O
Serratula tinctoria	A
Stachys officinalis	F
Succisa pratensis	F
Taraxacum sect Erythrosperma	O
Teucrium scorodonia	R
Trifolium micranthum	R
Trifolium repens	R
Veronica chamaedrys	R
Veronica officinalis	F
Viola riviniana	F
Mosses	
Campylopus introflexus	R
Dicranum scoparium	R
Hypnum cupressiforme agg	O
Polytrichum juniperinum	R
Pseudoscleropodium purum	O
Rhytidiadelphus squarrosus	O
Lichens	
Cladonia chlorophea	O

Total number of species = 66

Number of nationally rare species (**) = 1

Number of nationally scarce species (*) = 1

Number of acid grassland indicator species (@) = 3

New Forest SU 30
U20: Quadrat 2
Date of survey: 28/5/97

Species	Domin
Dwarf shrubs	
Calluna vulgaris	3
Erica cinerea	1
Grasses	
Agrostis capillaris	3
Anthoxanthum odoratum	3
Danthonia decumbens	2
Festuca filiformis	5
Festuca rubra	6
Molinia caerulea	4
Other vascular plants	
Anemone nemorosa	4
Bellis perennis	1
Carex caryophyllea	5
Carex montana	4
Carex panicea	2
Dactylorhiza maculata	1
Euphrasia nemorosa	2
Hypericum pulchrum	1
Hypochaeris radicata	3
Lotus corniculatus	3
Luzula campestris	1
Pilosella officinarum	3
Polygala serpyllifolia	2
Potentilla erecta	6
Prunella vulgaris	1
Pteridium acquilinum	4
Serratula tinctoria	4
Stachys officinalis	5
Succisa pratensis	3
Veronica officinalis	1
Viola riviniana	3
Lichens	
Cladonia chlorophea	1

Total number of species = 30
Quadrat size = 4m^2
Vegetation height = 1 - 5cm
Management: pony & cattle grazed and late summer Bracken mowing

Herb and grass-rich Bracken stand in a mown area with low hummocks. *Carex montana* present.

New Forest SU 30
U20: Quadrat 3
Date of survey: 28/5/97

Species	Domin
Grasses	
Agrostis capillaris	7
Anthoxanthum odoratum	2
Festuca rubra	3
Holcus mollis	2
Other vascular plants	
Anemone nemorosa	2
Bellis perennis	1
Carex montana	2
Carex panicea	2
Galium saxatile	1
Gladiolus illyricus	2
Hyacinthoides non-scripta	6
Hypericum pulchrum	1
Lonicera periclymenum	1
Polygala serpyllifolia	3
Potentilla erecta	4
Potentilla sterilis	4
Pteridium aquilinum	4
Ranunculus acris	2
Serratula tinctoria	5
Taraxacum sect Erythrosperma	1
Veronica chamaedrys	2
Viola riviniana	3
Mosses	
Pseudoscleropodium purum	2

Total number of species = 23
Quadrat size = 4m^2
Vegetation height = 2 - 10cm
Management: pony & cattle grazed

An uncut area of Bracken near woodland. The community has a greater accumulation of Bracken litter and has fewer grassland species.

6. Hampshire: Natural Area 70, Wealden Greensand

Woolmer Forest area, (SU7831) - disturbed heathland edge - U1

The site is a disturbed transport corridor which originated when a military railway (now abandoned) was built. The disturbance has created a wide variety of species-rich acid grassland including U1a, U1b, U1c, U1d and SD11a which occur within undisturbed H1 and H2 heath.

As part of a study of the impact of road widening on important acid grasslands just outside Woolmer Forest SSSI (Sanderson & Stanbury, 1996), 5 quadrats each were taken from U1a, U1c and U1b. These data are presented below as a constancy table illustrating the differences and similarities between these communities in this area.

During the Sanderson & Stanbury (1996) study, 32 lowland acid grassland indicator species were recorded from the area:

Grasses	*Plantago coronopus*
Aira caryophyllea	*Potentilla argentea*
Aira praecox	*Radiola linoides*
*Vulpia ciliata**	*Sedum acre*
Other vascular palnts	*Stellaria pallida*
Aphanes inexspectata	*Teesdalia nudicaulis*
Carex arenaria	*Trifolium ornithopodioides*
Cerastium diffusum	**Mosses**
Cerastium semidecandrum	*Tortula ruraliformis*
*Chamaemelum nobile**	**Lichens**
*Crassula tillaea**	*Cladonia arbuscula*
Erodium cicutarium	*Cladonia ciliata*
Erigeron acer	*Cladonia crispata*
Filago minima	*Cladonia foliacea*
*Hypochaeris glabra**	*Cladonia gracilis*
Moenchia erecta	*Cladonia uncialis*
Myosotis ramosissima	*Coelocaulon aculeatum*
Ornithopus perpusillus	*Peltigera rufescens*

Nationally scarce species (*) = 4
Acid grassland indicators = 32

Woolmer Forest area, Hampshire (SU7831)
Constancy table comparing U1a, U1c & U1b
From Sanderson & Stanbury (1996) EPR

Species	U1a	U1c	U1b	U1
Shared constants				
Agrostis capillaris	V	V	V	V
Aira praecox	V	V	V	V
Rumex acetosella	V	V	V	V
Polytrichum piliferum	V	III	IV	IV
Ulex europaeus	IV	IV	III	IV
Species preferential to U1a				
Cladonia furcata	V	II	III	IV
Festuca filiformis	V	III	III	IV
Cladonia c. cervicornis	V		II	III
Cladonia diversa	V		II	III
Cladonia portentosa	V		II	III
Coelocaulon aculeatum	IV	III	II	III
Deschampsia flexuosa	V	I	II	III
Cladonia crispata	V			II
Dicranum scoparium	V		I	II
Cladonia chlorophea	IV		I	II
Cladonia uncialis	IV			II
Hypnum jutlandicum	IV		I	II
Trapelia involuta	IV			II
Trapeliopsis flexuosa	III		I	II
Trapeliopsis granulosa	III			I
Cladonia gracilis	II			I
Pohlia nutans	II			I
Quercus robur	II			I
Senecio sylvaticus	II			I
Cladonia ciliata tenuis	I			I
Erica cinerea	I			I
Hypogymnia physodes	I			I
Rhizocarpon obscuratum	I			I
Stellaria pallida	I			I
Trapeliopsis pseudogranulosa	I			I
Species shared between U1a & U1c				
Filago minima	V	V		IV
Hypochaeris glabra	V	V		IV
Cerastium semidecandrum	IV	III		III
Teesdalia nudicaulis	IV	III	I	III
Cerastium diffusum	III	III		II
Peltigera rufescens	I	II		I
Species preferential to U1c				
Aphanes inexspectata		V	II	III
Erodium cicutarium	I	V		II
Brachythecium albicans		IV		II
Myosotis ramosissima	I	III	I	II
Sagina apetala	I	III		II
Arabidopsis thaliana		II		I
Erophila verna		II		I
Vulpia ciliata		II		I
Aira caryophyllea		I		I

Species	U1a	U1c	U1b	U1
Barbula convoluta		I		I
Dactylis glomerata		I		I
Hypericum perforatum		I		I
Leontodon saxatilis		I		I
Myosotis arvensis		I		I
Poa annua		I		I
Poa pratensis		I		I
Pseudoscleropodium purum		I		I
Sedum acre		I		I
Sedum album		I		I
Taraxacum Erythrosperma		I		I
Trifolium dubium		I		I
Tripleurospermum inodorum		I		I
Viola arvensis		I		I
Species preferential to U1b				
Polytrichum juniperinum	I	II	IV	III
Campylopus introflexus	II		IV	III
Festuca rubra			I	I
Funaria hygrometrica			I	I
Gymnocolea inflata			I	I
Juncus squarrosus			I	I
Pteridium aquilinum			I	I
Ranunculus bulbosus			I	I
Rubus fruticosus			II	I
Species shared between U1c & U1b				
Ornithopus perpusillus		II	III	II
Senecio jacobaea		II	I	I
Sonchus asper		II	I	I
Vulpia bromoides		II	I	I
Cerastium fontanum		I	I	I
Geranium molle		I	I	I
Rhytidiadelphus squarrosus		I	I	I
Species shared between U1a & U1b				
Calluna vulgaris	II		I	I
Shared non-constants				
Hypochaeris radicata	II	II	I	III
Ceratodon purpureus	I	II	I	II
Luzula campestris	I	II	I	II
Veronica arvensis	I	I	I	I
Total Number of Samples	5	5	5	15
Total Number of Species	46	50	42	80
Mean Number of Species	27.8	22.0	15.4	21.7
Bare ground (mean %)	4.6	5.2	2.4	

U1a = Festuca-Agrostis-Rumex Grassland, Cornicularia-Cladonia sub-community
U1c = Festuca-Agrostis-Rumex Grassland, Erodium-Teesdalia sub-community
U1b = Festuca-Agrostis-Rumex Grassland, Typical sub-community
Quadrat size = 4m^2

7. Hereford and Worcester: Natural Area 43, Midlands Plateau

Hurcott Pasture SSSI (SO8477) - enclosed pasture - U1f

Hurcott Pasture is located in north Worcestershire, on the eastern edge of Kidderminster. The 4.7 ha site occupies the edge of a plateau and the valley slopes to the south and west. The higher ground has freely draining sandy soils developed on the Bunter Sandstones, supporting parched acid grassland (U1f). Lower slopes, especially in shallow hollows have damper soils with neutral grassland (MG6b).

Notes on vegetation and flora

U1 grassland dominates much of the site and is closest to U1f. As is typical of U1f, the only Fescue present is *Festuca rubra*, while *Festuca ovina* agg is absent. *Vulpia bromoides*, *Agrostis capillaris* and *Aira praecox* are also abundant. The vegetation ranges from very short, open, *Polytrichum juniperinum-Aira praecox* swards (**Quadrat 1**) to denser swards with a high herb cover, especially to the east (**Quadrat 2**). To the west some weedy, disturbed, patches occur with abundant *Senecio jacobaea*, Thistles and *Urtica dioica*. A total of 56 species were recorded from the U1f grassland. The acid grassland flora is rich for a small, enclosed, site. Seven acid grassland indicator species are present. The SSSI citation notes others not seen in 1997.

Management

The field is lightly horse-grazed. The horses were removed at the time of survey. The weedy latrine areas may be related to past over-grazing, not the current management. Some limited rabbit grazing occurs.

Conservation value

A good quality example of an enclosed acid grassland. U1f is typical of such situations, ie dry but not strongly acid soils. This stand is likely to be near the edge of the national distribution of U1f, which appears to have a south-western distribution (Rodwell 1992).

Hurcott Pasture, Worcester
U1f: Community list

Date of survey: 19/5/97

Species	DAFOR
Trees & tall shrubs	
Crataegus monogyna	E
Sambucus nigra	E
Ulex europaeus	E
Grasses	
Agrostis capillaris	A
Aira praecox @	A
Anthoxanthum odoratum	F
Bromus hordeaceus	O
Dactylis glomerata	O
Festuca rubra	A
Holcus mollis	O
Lolium perenne	O
Vulpia bromoides	A
Other vascular plants	
Achillea millefolium	F
Aphanes inexspectata @	A
Bellis perennis	R
Carduus nutans	O
Carex hirta	R
Carex muricata lamprocarpa	R
Cerastium arvense @	O
Cerastium fontanum	O
Cerastium semidecandrum @	F
Cirsium vulgare	O
Conopodium majus	O
Crepis capillaris	O
Digitalis purpurea	E
Erodium cicutarium @	O
Galium verum	R
Geranium molle	A

Species	DAFOR
Hypochaeris radicata	A
Lotus corniculatus	O
Luzula campestris	F
Myosotis discolor	O
Ornithopus perpusillus @	A
Pilosella officinarum	A
Plantago lanceolata	F
Ranunculus bulbosus	F
Rubus fruiticosus	E
Rumex acetosella	A
Senecio jacobaea	F
Silene latifolia	O
Stellaria media	R
Taraxacum sect Erythrosperma	O
Trifolium dubium	O
Trifolium repens	O
Trifolium striatum @	F
Urtica dioica	O
Veronica arvensis	F
Veronica chamaedrys	O
Veronica serpyllifolia	R
Vicia sativa nigra	O
Viola arvensis	R
Mosses	
Brachythecium albicans	A
Ceratodon purpureus	A
Polytrichum juniperinum	A
Pseudoscleropodium purum	O
Lichens	
Cladonia furcata	R

Total number of species = 56
Number of acid grassland indicator species (@) = 7

E = edge

Additional indicator species noted on SSSI citation

Cerastuim arvense
Spergularia rubra

Note: The English Nature record of *Vicia lathyroides* could be an error for small *Vicia sativa nigra*.

Hurcott Pasture
U1f: Quadrat 1
Date of survey: 29/5/97

Species	DAFOR
Grasses	
Agrostis capillaris	5
Aira praecox	6
Festuca rubra	5
Vulpia bromoides	5
Other vascular plants	
Aphanes inexspectata	2
Cerastium semidecandrum	2
Geranium molle	2
Hypochaeris radicata	4
Ornithopus perpusillus	4
Pilosella officinarum	2
Plantago lanceolata	2
Ranunculus bulbosus	2
Rumex acetosella	6
Senecio jacobaea	1
Taraxacum sect Erythrosperma	2
Veronica arvensis	2
Vicia sativa nigra	1
Mosses	
Brachythecium albicans	4
Ceratodon purpureus	5
Polytrichum juniperinum	7

Total number of species = 20
Quadrat size = 4m^2
Vegetation height = 1-4cm
Management: horse grazed but rested at time of survey.

Quadrat placed on open, short, *Polytrichum* and *Aira*-dominated U1f.

Hurcott Pasture
U1f: Quadrat 2
Date of survey: 29/5/97

Species	DAFOR
Grasses	
Agrostis capillaris	4
Aira praecox	5
Festuca rubra	6
Vulpia bromoides	6
Other vascular plants	
Achillea millefolium	4
Aphanes inexspectata	3
Carduus nutans	1
Cerastium fontanum	2
Cerastium semidecandrum	3
Geranium molle	3
Hypochaeris radicata	3
Lotus corniculatus	4
Ornithopus perpusillus	3
Pilosella officinarum	4
Plantago lanceolata	4
Ranunculus bulbosus	3
Rumex acetosella	6
Senecio jacobaea	4
Trifolium dubium	4
Trifolium striatum	5
Vicia sativa nigra	4
Mosses	
Brachythecium albicans	3
Polytrichum juniperinum	1

Total number of species = 23
Quadrat size = 4m^2
Vegetation height = 1-6cm
Management: horse grazed but rested at time of survey.

Quadrat placed in more herb-rich area of U1f with lower moss cover.

8. Humberside: Natural Area 34, North Lincolnshire Coversands and Clay Vales

a. Risby Warren (SE9213) - grass heath - U1c

Site Description

Risby Warren is the largest surviving area of Coversand heathland, and the SSSI covers 150ha. It is private land. It is an Grade 1 NCR site and was surveyed by Wigginton (1990). The survey card for Risby Warren could not be found but the 1988 report indicates that the vegetation at the time included 80ha of U1, 38.8ha of Bracken and 9.44ha of *Brachypodium pinnatum*-dominated vegetation. The bulk of the U1 vegetation was not identified to sub-community level (56.52ha) with 23.24ha of U1a and 1ha of U1c. The site consists of windblown sand over Jurassic limestone. The limestone is exposed on the surface as fragments but does not have an obviously strong effect on the vegetation. As well as stable dunes there are active dunes in the north-west.

Notes on Vegetation

The most surprising feature of the heathland, found when the site was visited on 20/5/97, was the dominance of high quality U1c. A quadrat (Q1) was taken and a community species list made (see below). The quadrat contained a remarkable 38 species and a total of 67 were recorded from the community. Three species were nationally scarce and 23 were dry acid grassland indicator species. (Wigginton recorded 3 more indicator species from the site). Patches of *Calluna* occur in the U1c locally but are currently being suppressed by heavy rabbit grazing. Older bushes seem to be declining, but some regeneration was noted.

A little U1a was noted and in places the U1c graded into less herb-rich U1b. The stable dunes examined had heavily-grazed U1b with a high *Carex arenaria* cover and some lichen-rich *Carex* dune community, SD11b. Moribund Marram grass could be seen in the south-east, on now stable dunes planted in the 1920s, on what were then mobile dunes. In the north-east an active blow out and dune system has developed which lacks Marram. The blow out has an open growth of *Erodium cicutarium, Cerastium semidecandrum* and *Poa annua* while the dune has a pioneer dune community of *Carex arenaria* with *Teucrium scorodonia* and *Senecio jacobaea* growing through from the buried sward. This may be the only true inland pioneer *Carex arenaria* dune in Britain at the moment.

The *Brachypodium pinnatum* vegetation is a curious feature. It has been said to be associated with the thinner sands over the limestones, but in fact it can be found on top of dunes, so is not restricted to limestone areas but is probably more frequent on areas with limestone. The areas examined were mostly extremely species-poor, over-grown, stands. Where rabbit grazing had kept down the *Brachypodium* the grassland appeared closer to U1d than CG4. The frequency of *Teucrium scorodonia* is a distinctive feature which is very atypical of any CG4 sub-communities. It is possible that true CG4 did once occur here but its distinctiveness has been lost in the over growth of the grass.

Management

The combination of very high rabbit grazing and WES-funded Bracken cutting appears to have transformed the site since 1988. There is now well over 50ha of U1c of very high quality. Rabbit grazing is maintaining the condition of the U1 grassland but rabbit populations are liable to crash and the rabbits are having little effect on the *Brachypodium*. There has been a trial with sheep grazing in a small area but these have also had no effect on the *Brachypodium*. On seeing the site, the best solution would appear to be to introduce a small number of ponies to keep down the *Brachypodium*, and to introduce sheep if the rabbit population crashes. The site will need ring-fencing but the current rabbit fencing which nearly surrounds the site is probably adequate to fence in ponies.

Conservation Value

Other than the Stanford Training Area in Breckland, this is the only large stand of U1c known in Britain at the moment. It may be the largest as no figures exist for the Stanford Training Area. The mobile dune area is also probably the best mobile inland dune in the country, with associated stabilised dunes. As such this site may be of international significance (along with other heathlands in the area) as well as national significance.

Risby Warren
U1c: Community species list
Date of survey: 20/5/97

Species	DAFOR
Grasses	
Agrostis capillaris	A
Agrostis vinealis	O
Aira praecox @	A
Brachypodium pinnatum	O
Festuca filiformis	F
Festuca ovina	O
Holcus lanatus	R
Poa pratensis	F
Vulpia bromoides	O
Other vascular plants	
Anagallis arvensis	R
Aphanes inexspectata @	A
Botrychium lunaria	R
Campanula rotundifolia	R
Carex arenaria @	O
Carlina vulgaris	O
Centaurium erythraea	O
Cerastium arvense @	O
Cerastium semidecandrum	F
Chamerion angustifolium	O
Cirsium arvense	O
Cynoglossum officinale	O
Echium vulgare @	O
Erodium cicutarium @	F
Erophila verna	F
Filago minima @	A
Geranium molle	P
Hypochaeris glabra @ *	O
Lotus corniculatus	R
Luzula campestris	F
Myosotis ramosissima @	F
Ornithopus perpusillus @	O
Pilosella officinarum	O
Plantago coronopus @	O
Prunella vulgaris	R
Pteridium aquilinum	F
Rumex acetosella	F
Sagina apetala	R
Sagina procumbens	F
Sedum acre @	F
Senecio jacobaea	F
Taraxacum sect Erythrosperma	O
Teesdalia nudicaulis @	O
Teucrium scorodonia	A
Trifolium dubium	O
Veronica arvensis	F
Vicia lathyroides @	R
Viola canina @	O
Mosses and liverworts	
Brachythecium albicans	A
Bryum sp	O
Bryum argenteum	O
Ceratodon purpureus	A
Dicranum scoparium	F
Hypnum cupressiforme lacunosum @	F
Polytrichum juniperinum	A
Ptilidium ciliare @	O
Lichens	
Cladonia arbuscula @	R
Cladonia c. cervicornis	F
Cladonia cariosa @ *	R
Cladonia chlorophea	O
Cladonia diversa	O
Cladonia foliacea @	A
Cladonia furcata	A
Cladonia rangiformis	O
Cladonia uncialis @	R
Coelocaulon aculeatum @	F
Peltigera canina @ *	R
Peltigera lactucifolia	O

Total number of species = 67
Number of nationally scarce species (*) = 3
Number of acid grassland indicator species (@) = 23
Additional indicator species recorded by Wigginton (1990) = 3
Aira caryophyllea @ *Erigeron acer* @ *Sagina nodosa* @
Number of acid grassland indicator species on site (@) = 26

P = present, no DAFOR given

Risby Warren
U1c: Quadrat 1
Date of survey: 20/5/97

Species	Domin
Grasses	
Agrostis capillaris	6
Agrostis vinealis	4
Aira praecox	5
Poa pratensis	3
Other vascular plants	
Aphanes inexspectata	4
Centaurium erythraea	2
Cerastium arvense	3
Cerastium semidecandrum	3
Erodium cicutarium	3
Erophila verna	3
Filago minima	3
Geranium molle	3
Hypochaeris glabra	4
Luzula campestris	2
Myosotis ramosissima	3
Plantago coronopus	2
Pteridium aquilinum	1
Rumex acetosella	2
Sagina apetala	1
Sagina procumbens	3
Sedum acre	5
Senecio jacobaea	2
Taraxacum sect Erythrosperma	1
Teesdalia nudicaulis	3
Teucrium scorodonia	3
Veronica arvensis	3
Viola canina	1
Mosses	
Brachythecium albicans	2
Bryum sp	2
Bryum argenteum	1
Ceratodon purpureus	4
Dicranum scoparium	4
Hypnum c. lacunosum	3
Polytrichum juniperinum	6
Lichens	
Cladonia furcata	4
Coelocaulon aculeatum	2
Peltigera canina	3
Peltigera lactucifolia	1

Total number of species = 38
Quadrat size $4m^2$
Vegetation height = 0-1cm
Management: heavily rabbit grazed

b. Manton and Twigmoor SSSI and adjacent areas (SU9404) - grass heath, stablised sand dune, arable reversion - U1, SD11b, H11a

Background

The area examined includes the southern part of Manton & Twigmoor SSSI and adjacent areas of early-succession acid grassland, developed on former arable fields put into Countryside Stewardship in 1992. The SSSI had been surveyed by Wigginton (1990). Wigginton recorded 27.56ha of Bracken (U20a), 4.04ha of heath (H11), 3.8ha of U1c, 0.01ha of U1a, 5.2ha of undefined acid grassland and dune, 2.4ha *Deschampsia flexuosa* grassland (U2a) and 0.24ha of *Brachypodium pinnatum* grasland (CG4).

Part of the SSSI, called Manton Warren South, and an area to the south in the Countryside Stewardship Scheme were surveyed together, with a total site species list made from the heathland communities. A selection of the quadrats recorded are reproduced below. An area adjacent to the northern edge of Manton Warren South has been entered into the Stewardship Scheme, and was also surveyed. Two quadrats and a total species list are given below.

Physical Features

The sites consist of windblown sand over Jurassic limestone. There are stablised sand dunes, as well as an old sand quarry in which some limestone is exposed on the surface. The northern Stewardship field has developed active blow outs and dunes since 1992.

Manton Warren South & southern Stewardship field

Vegetation

The Warren has a complex mixture of high quality acid grasslands as well as areas degraded by Bracken invasion. Since 1988, heavy rabbit grazing and mowing of Bracken under WES has clearly greatly improved the quality of the acid grassland, but there is a problem with Rosebay Willowherb invasion, which the rabbits will not graze. The southern Stewardship field has an impressive area of early-succession U1c grassland but lacks the recent blowouts and dunes of the northern field. The vegetation comprises the following types:

U1a: 2.03ha, very lichen rich, mainly found in the quarry floor.

U1b: 9.03ha, greatly extended by the mowing of Bracken. Rosebay Willowherb invasion is a problem. Includes transitions to SD10, where grazing is converting derelict, rank, *Carex arenaria* swards back to

U1b swards (and possibly SD11 if lichens recolonise).

U1c (late succession): 0.2ha, small areas in quarry floor and in north.

U1c (early succession): 9.95ha, developing on Stewardship restoration areas.

SD11b: 1.01ha, on sand dunes.

H11a: 1.99ha, on old dunes and in quarry. *Ericaceous* species are heavily rabbit grazed.

U1d/CG4: 0.08ha, on limestone and sand mixtures in quarry.

Wigginton's site map is too unclear to interpret easily but his data indicates the disappearance of U2a due to increased rabbit grazing .

Flora

A total of 86 species were recorded from the open heathland. These included one nationally scarce species, *Hypochaeris glabra*, and 21 dry acid grassland indicator species. An unusual record was that of *Ranunculus parviflorus*, with a few plants in disturbed areas, possibly on introduced soil, within parched acid grassland (U1). This record appears to be the first post-1970 record for Lincolnshire and one of the few modern records for eastern England.

Management

The WES-funded mowing of Bracken combined with heavy rabbit grazing is maintaining the condition of the site well, with the exception of the Rosebay Willowherb. This will need controlling, in the short term swiping or applying herbicide with a weed wipe should suffice but in the long term a ring fence and light stock grazing would be best. More scrub clearance is required to open up the central area.

Manton Warren South
Species List, Open Heathland
Date of survey: 21/5/97

Species	DAFOR
Dwarf shrubs	
Calluna vulgaris	O
Erica cinerea	F
Grasses	
Agrostis capillaris	F
Agrostis vinealis	O
Aira caryophyllea @	R
Aira praecox @	A
Brachypodium pinnatum	O
Deschampsia flexuosa	O
Festuca filiformis	F
Holcus mollis	O
Holcus lanatus	O
Poa pratensis	F
Vulpia bromoides	O
Other vascular plants	
Anchusa arvensis	O
Anchusa ochroleuca	O
Aphanes inexspectata @	F
Arenaria serpyllifolia	O
Carex arenaria @	A
Centaurium erythraea	O
Cerastium arvense @	O
Cerastium fontanum	R
Cerastium semidecandrum @	F
Chamerion angustifolium	F
Cirsium arvense	O
Erodium cicutarium @	O
Filago minima @	O
Fragaria vesca	R
Galium saxatile	O
Galium verum	O
Geranium molle	O
Glechoma hederacea	O
Hypochaeris glabra * @	R
Lotus corniculatus	R
Luzula campestris	F
Myosotis ramosissima @	F
Pilosella officinarum	O
Prunella vulgaris	O
Pteridium aquilinum	A
Ranunculus parviflorus	R
Rumex acetosella	F
Sagina procumbens	F
Senecio jacobaea	O
Taraxacum sect Erythrosperma	O
Teesdalia nudicaulis @	O
Teucrium scorodonia	F
Urtica dioica	O
Urtica urens	O
Veronica arvensis	O
Veronica serpyllifolia	R
Viola arvensis	O
Viola canina @	O
Mosses	
Brachythecium albicans	F
Campylopus introflexus	O
Ceratodon purpurea	F
Dicranum scoparium	A
Hypnum lacunosum tectorum @	F
Hypnum jutlandicum	O
Pohlia nutans	R
Polytrichum juniperinum	A
Polytrichum piliferum	O
Pseudoscleropodium purum	O
Racomitrium elongatum @	O
Tortula ruralis ruralis	R
Liverworts	
Ptilidium ciliare @	F
Lichens	
Cladonia arbuscula @	F
Cladonia c. cervicornis	O
Cladonia chlorophea	F
Cladonia ciliata @	F
Cladonia diversa	O
Cladonia foliacea @	A
Cladonia furcata	A
Cladonia gracilis @	F
Cladonia portentosa	O
Cladonia rangiformis	O
Cladonia scrabriuscula	R
Cladonia subulata	O
Cladonia uncialis @	F
Coelocaulon aculeatum @	F
Hypogymnia physodes	O
Lepraria incana	O
Peltigera didactyla	O
Peltigera lactucifolia	R
Peltigera rufescens @	R
Placynthiella uliginosa	O
Trapeliopsis flexuosa	R
Trapeliopsis granulosa	O

Total number of species = 86
Number of nationally scarce species (*) = 1
No of acid grassland indicator species (@) = 22

Additional indicator species recorded by Wigginton (1990):
Echium vulgare @ & *Sagina nodosa* @
No of acid grassland indicator species (@) = 24

Manton Warren South
U1b: Quadrat 1
Date of survey: 21/5/97

Species	Domin
Grasses	
Agrostis capillaris	6
Aira praecox	4
Poa pratensis	4
Other vascular plants	
Aphanes inexspectata	2
Cerastium semidecandrum	2
Filago minima	1
Sagina procumbens	1
Veronica arvensis	3
Mosses	
Brachythecium albicans	7
Ceratodon purpurea	2
Dicranum scoparium	1
Hypnum c. lacunosum	4
Polytrichum juniperinum	5
Polytrichum piliferum	3
Lichens	
Cladonia chlorophea	1
Cladonia foliacea	4
Cladonia furcata	4
Coelocaulon aculeatum	1
Bare soil	4

Total number of species = 19
Quadrat size = $4m^2$
Vegetation height = 0-1cm
Management: heavily rabbit grazed.

Moss-dominated and with lichens and *Agrostis capillaris* prominent. Close to U1c, but not rich enough for classification as U1c

Manton Warren South
SD11b: Quadrat 3
Date of survey: 21/5/97

Species	Domin
Grasses	
Agrostis capillaris	1
Other vascular plants	
Carex arenaria	7
Myosotis ramosissima	2
Rumex acetosella	3
Teesdalia nudicaulis	3
Teucrium scorodonia	2
Viola canina	1
Mosses	
Ceratodon purpurea	3
Dicranum scoparium	1
Polytrichum juniperinum	5
Lichens	
Cladonia arbuscula	5
Cladonia foliacea	6
Cladonia furcata	6
Cladonia gracilis	1
Cladonia uncialis	1
Coelocaulon aculeatum	4
Bare soil	3

Total number of species = 16
Quadrat size = $4m^2$
Vegetation height = 0-3cm
Management: heavily rabbit grazed

Stabilised sand dune, dominated by *Carex arenaria* and lichens

Manton Warren South **H11a: Quadrat 4** Date of survey: 21/5/97	
Species	**Domin**
Dwarf shrubs	
Calluna vulgaris	5
Erica cinerea	7
Grasses	
Agrostis capillaris	2
Aira praecox	1
Deschampsia flexuosa	4
Festuca filiformis	3
Poa pratensis	2
Other vascular plants	
Carex arenaria	4
Luzula campestris	5
Rumex acetosella	2
Teucrium scorodonia	3
Viola canina	2
Mosses	
Dicranum scoparium	5
Hypnum c. lacunosum	4
Hypnum jutlandicum	5
Liverworts	
Ptilidium ciliare	4
Lichens	
Cladonia arbuscula	3
Cladonia ciliata	4
Cladonia foliacea	2
Cladonia furcata	2
Cladonia subulata	1
Coelocaulon aculeatum	3
Bare soil	2

Total number of species = 22
Quadrat size = 4m^2
Vegetation height = 0-8cm
Management: heavily rabbit grazed.

Heath on stabilised dunes, *Calluna* and *Erica* rabbit-grazed, with *Calluna* prostrate and the less palatable *Erica cinerea* in browsed bushes

Manton Warren South **U1a: Quadrat 6** Date of survey: 21/5/97	
Species	**Domin**
Dwarf shrubs	
Erica cinerea	3
Grasses	
Agrostis capillaris	2
Agrostis vinealis	3
Aira praecox	3
Deschampsia flexuosa	3
Other vascular plants	
Carex arenaria	1
Luzula campestris	4
Pteridium aquilinum	1
Rumex acetosella	2
Senecio jacobaea	1
Teesdalia nudicaulis	2
Veronica arvensis	1
Mosses	
Campylopus introflexus	3
Ceratodon purpurea	4
Polytrichum piliferum	2
Liverworts	
Ptilidium ciliare	3
Lichens	
Cladonia arbuscula	4
Cladonia c. cervicornis	1
Cladonia ciliata	6
Cladonia foliacea	3
Cladonia furcata	3
Cladonia uncialis	8
Coelocaulon aculeatum	3
Bare soil	4

Total number of species = 23
Quadrat size = 4m^2
Vegetation height = 0-1cm
Management: heavily rabbit grazed.

Rich U1a in old sand pit.

Northern Stewardship field

Vegetation

Since 1992 the field has developed an early-succession form of U1c, covering 5.95 ha. The vegetation is very heavily rabbit-grazed, with the result that the sand is mainly being stabilised by moss mats dominated by *Brachythecium albicans* and *Ceratodon purpureus*. To the west the surface is so destabilised that blow outs and a dune are developing, perhaps initially from a small sand pit on the southern edge of the field. The vegetation consists of annual herbs typical of U1c, with much *Aira praecox* and variable amounts of ruderal species such as *Cirsium arvense* and *Senecio jacobaea*. Many typical grasses such as *Agrostis capillaris* and *Festuca ovina* agg are rare or absent, as are many lichen species as these appear to be late colonists. Some species such as *Carex arenaria* and *Cerastium arvense* are spreading in from surviving plants on the field margins and there is some late-succession U1c on the western field margin. The dune lacks *Carex arenaria* but is otherwise similar to the active dune at Risby Warren, with *Cirsium arvense*, *Senecio jacobea*, *Anchusa arvensis*, *Erodium cicutarium* and *Poa annua*. Two grazing-exclusion plots have been set up and illustrate the importance of grazing in restoring acid grassland, as they are poorer in species, with low cover of bryophytes and ephemeral vascular plants.

Flora

A total of 55 species were recorded from the field, of which 2 were nationally scarce species, *Hypochaeris glabra* and *Vulpia ciliaris ambigua*, the latter a new 10km square record. A total of 11 dry acid grassland indicator species were recorded including *Filago minima*. The flora is remarkably rich in parched acid grassland specialist species considering that the grassland is only 5 years old.

Management

The perennial weeds will require control and in the long term grazing by suitable stock should be considered. The hedges planted along the southern and western edge threaten to isolate the developing grass heath from the rest of the heathland to the south and ideally should be removed.

Overall conservation value of Manton Warren South and Stewardship fields

The area has excellent acid grassland vegetation with a rich flora. A total of 2 nationally scarc and 23 dry acid grassland indicator species were recorded from the area examined, and Wigginton (1990) recorded 2 more species. The area has a remarkable collection of inland blown sand communities, including active dunes and should be considered with Risby Warren as part of site of possible international significance.

Northern Countryside Stewardship field
Total species list
Date of survey: 21/5/97

Species	DAFOR
Grasses	
Agrostis capillaris	R
Agrostis stolonifera	O
Aira praecox @	A
Dactylis glomerata	O
Elytrigia repens	R
Festuca rubra	O
Holcus lanatus	O
Poa annua	A
Poa pratensis	F
Vulpia bromoides	R
Vulpia ciliata ambigua * @	R
Other vascular plants	
Anchusa arvensis	F
Anchusa ochroleuca	O
Aphanes inexspectata @	A
Arabidopsis thaliana	F
Arenaria serpyllifolia	F
Capsella bursa-pastoris	R
Cardamine hirsuta	R
Carex arenaria @	O
Cerastium arvense @	R
Cerastium fontanum	R
Cerastium semidecandrum @	F
Cirsium arvense	A
Cirsium vulgare	O
Claytonia perfoliata	O
Erodium cicutarium @	A
Erophila verna	F
Filago minima @	R
Geranium molle	A
Glechoma hederacea	O
Hypochaeris glabra * @	R
Myosotis arvensis	R
Myosotis ramosissima @	A
Pteridium aquilinum	R
Rumex acetosella	O
Rumex obtusifolius	O
Sagina procumbens	A
Senecio jacobaea	A
Silene latifolia	R
Taraxacum sp.	R
Trifolium dubium	O
Urtica dioica	F
Urtica urens	R
Veronica arvensis	A
Vicia sativa nigra	R
Viola arvensis	R
Mosses	
Brachythecium albicans	A
Brachythecium rutabulum	R
Bryum argenteum	F
Ceratodon purpureus	A
Tortula ruralis ruralis	O
Lichens	
Cladonia chlorophea	O
Cladonia foliacea @	R
Cladonia humilis	R
Peltigera didactyla	O

Total number of species = 55
Number of nationally scarce species (*) = 2
Number of acid grassland indicator species (@) = 11

Northern Countryside Stewardship field U1c (early succession form): Quadrat 1 Date of survey: 21/5/97	
Species	**Domin**
Grasses	
Agrostis stolonifera	2
Aira praecox	4
Dactylis glomerata	1
Poa annua	4
Poa pratensis	1
Other vascular plants	
Anchusa arvensis	2
Anchusa ochroleuca	2
Aphanes inexspectata	2
Arabidopsis thaliana	3
Arenaria serpyllifolia	3
Cerastium semidecandrum	3
Cirsium arvense	2
Cirsium vulgare	1
Erodium cicutarium	4
Erophila verna	2
Geranium molle	6
Myosotis ramosissima	3
Rumex acetosella	1
Sagina procumbens	4
Senecio jacobaea	3
Trifolium dubium	2
Veronica arvensis	3
Mosses	
Brachythecium albicans	3
Brachythecium rutabulum	2
Bryum argenteum	2
Ceratodon purpureus	3
Tortula ruralis ruralis	3
Bare soil	6

Total number of species = 27
Quadrat size = 4m^2
Vegetation height = 0-2cm
Management: heavily rabbit grazed Countryside Stewardship land reverting from arable. Last arable in 1992.

Quadrat placed on fairly typical area of early-succession U1c, near the NE exclusion plot. Some areas have higher levels of perennial weeds. *Rumex acetosella* mainly as seedlings in rabbit grazed areas.

Northern Countryside Stewardship field U1c (early succession form): Quadrat 2 Date of survey: 21/5/97	
Species	**Domin**
Grasses	
Aira praecox	6
Holcus lanatus	2
Poa annua	4
Poa pratensis	2
Vulpia bromoides	2
Other vascular plants	
Aphanes inexspectata	3
Arenaria serpyllifolia	1
Cerastium semidecandrum	3
Erodium cicutarium	3
Erophila verna	1
Filago minima	1
Hypochaeris glabra	2
Myosotis ramosissima	3
Sagina procumbens	6
Senecio jacobaea	3
Veronica arvensis	3
Mosses	
Bryum argenteum	2
Ceratodon purpureus	3
Lichens	
Cladonia chlorophea	1
Bare soil	8

Total number of species = 19
Quadrat size = 4m^2
Vegetation height = 0-1cm
Management: heavily rabbit grazed Countryside Stewardship land reverting from arable. Last arable in 1992.

Quadrat placed where slight blown sand accumulations are occurring. A very open stand with *Hypochaeris glabra* and *Filago minima* present, a remarkable stand for a site only 5 years old.

9. Kent and Sussex (East): Natural Area 71, Romney Marshes

Dungeness SSSI (TR0518) - non-maritime grassland on shingle - U1a

The SSSI includes extensive areas of acid grassland on stable shingle beaches. It was surveyed by Ferry et al (1990) in the 1980's. As part of the study a classification of the shingle vegetation was produced and related to NVC communities. Quadrat size was generally 2x4m and occasionally 1x4m, with 53 quadrats from types equivalent to U1, with a further 30 from variants of these types. NVC sub-communities identified include U1a (220.9 ha), U1d (54.5 ha) and U1f (33.0 ha). In some cases only general affinities to NVC communities could be identified, for example Type A25 (72.8 ha) (U1) which had no obvious relation to any sub-community of U1. The conditions of very well-drained shingle, and an annual rainfall of less than 800mm, with less than 140 wet days per annum, provides suitable conditions for the development of U1 (Ferry et al 1990).

The U1a sub-community at Dungeness is characterised by *Festuca tenuifolia* replacing *F. ovina* as the constant and sometimes dominant grass. The nationally scarce species, *Silene nutans* occurs in the sub-community as well as a rich bryophyte and lichen flora. The type occurs where disturbance of the shingle surface is absent or very slight and is replaced by variants and other types on more disturbed areas, including a U1d-equivalent type. The area of U1a (over 200 ha) at Dungeness may be the most extensive stand of this sub-community anywhere in Britain. An extract of quadrat data from Ferry et al (1990) is given below, comparing the table for U1a from the NVC (Volume 3) and the U1a found at Dungeness. According to Ferry the site is largely ungrazed by stock but rabbit populations have recovered after massive declines due myxomatosis in the 1950s. Ferry suggests that stock grazing may have been responsible for increasing the mesotrophic component of some of the acid grassland swards.

Dungeness SSSI
Constancy table for U1a
Date of survey - 1980's (Latin names follow those in the NVC).

Species	NVC U1a		Dungeness U1a	
	Constancy	Domin	Constancy	Domin
Festuca ovnia	V	3-9	I	1
Agrostis capillaris	II	2-3	I	1-4
Rumex acetosella	I	1-4	V	1-7
Dicranum scoparium	IV	3-8	V	3-9
Coelocaulon aculeata	IV	3-8	V	1-3
Cladonia arbuscula	IV	2-6		
Polytrichum piliferum	III	2-7		
Cladonia ciliata	III	2-6	V	1-8
Cladonia portentosa	III	2-7	IV	1-5
Cladonia foliacea	III	2-3	III	1-2
Cladonia uncialis	III	2-5	I	1-3
Cladonia furcata	II	2-3	II	1-2
Cladonia squamosa	II	2-3	I	1
Cladonia gracilis	II	2-3	II	1-3
Ptilidum ciliare	II	2-6		
Pohlia nutans	II	1-4		
Cladonia fimbriata	II	3-4		
Cladonia pyxidata	II	3-4		
Campylopus introflexus	I	3-8	I	1-2
Brachythecium albicans	I	4-5		
Holcus lanatus	I	3-4	I	1
Galium saxatile	I	2		

Species	NVC U1a		Dungeness U1a	
	Constancy	Domin	Constancy	Domin
Hieracium pilosella	I	3	II	1-4
Senecio jacobaea	I	2		
Koeleria macrantha	II	3-4		
Hypnum cupressiforme s.l.	II	2-8	I	1-2
Calluna vulgaris	I	2		
Ceratodon purpureus	I	1-2	I	2
Polytrichum juniperinum	II	3-4	II	1-4
Pseudoscleropodium purum	I	5		
Pteridium aquilinum	I	2-3		
Rhytidiadelphus squarrosus	I	2		
Epilobium angustifolium	I	2		
Pleurozium schreberi	I	2		
Aira praecox			IV	1-2
Cerastium fontanum			I	1
Teesdalia nudicaulis			II	1-3
Anthoxanthum odoratum			V	1-4
Hypochoeris radicata			II	1-3
Sedum anglicum			III	1-2
Cuscuta epithymum			III	1-2
Cladonia verticillata			II	1-4
Cladonia floerkeana			I	1
Cytisus scoparius (ground)			I	4-6
Cladonia chlorophaea agg			III	1-3
Hypogymnia physodes			I	1
Festuca tenuifolia			V	1-8
Silene nutans			III	2-4
Teucrium scorodonia			V	1-8
Cladonia rangiformis			I	1-2
Rumex acetosa			III	1-3
Silene vulgaris subsp maritima			II	2-5
Bryum capillare			II	1
Poa compressa			I	1
Vicia hirsuta			I	1
Peltigera polydactyla			I	1
Cladonia polydactyla			I	1

Number of samples	18	19
Number of species per sample	7-20	9-20
Average number of species per sample	14	15

10. Kent: Natural Area 70, Wealden Greensand

Hatch Park SSSI (TR0641) - parkland - U1

Physical Features

The Park lies over freely draining sand, with flushes occurring locally on lower ground. The southern margin is marked by a shallow valley which has been dammed to create four ornamental ponds. There is an old sand pit in the north.

Vegetation Types

The dominant form of acid grassland is U1e, locally tending to U1d, with a fairly closed sward with few lichens and a variable bryophyte cover. Ephemeral species can be frequent where the grassland is rabbit grazed, or where moles are active, or in areas trampled by people. Areas only grazed by deer are quite poor in species. In contrast, in the old sand pit where the thick humus layer found under U1e elsewhere is absent, U1b and U1a (on south facing slopes) have developed and have a richer lower plant flora. The local lichen *Cladonia foliacea* occurs in the U1a type. Quadrat samples were taken from the dominant, more mesic, U1 grasslands (U1e and U1d/e) and the more restricted xeric stands (U1a and U1b). Four quadrats are reproduced below.

Bracken stands (U20) predominate in some places and have a local abundance of woodland species such as *Hyacinthoides*. Elsewhere a few enriched areas to the north grade to MG6b and the wet areas have a variety of communities including M6d, M25b, M23a and MG10b.

The Park has an impressive collection of ancient trees including Oak, Ash and Hornbeam, including many in-cycle pollards to the south. The main pollard orchard was over-run by Rhododendron, which has been cleared recently to produce an early successional form of U1b.

Flora

A total of 114 species were recorded on 29/4/97, of which 57 were found in the acid grassland. A total of 6 acid grassland indicator species were seen, *Aira praecox*, *Aphanes inexpectata*, *Ornithopus perpusillus*, *Cladonia ciliata*, *Cladonia foliacea* and *Coelocaulon aculeatum*. At least two others, *Moenchia erecta* and *Trifolium subterraneum*, have been recorded in the past and a survey in May or early June would probably produce more indicator species.

Management

The Park is still deer grazed. The sward, which rather densely matted in most places, could be improved by some cattle grazing. It is planned to reduced the area of Bracken and this should produce open, good quality, U1 grassland if open bare ground is created as a result.

Hatch Park SSSI
U1d/e: Quadrat 2
Date of survey: 29/4/97

Species	Domin
Grasses	
Agrostis capillaris	8
Aira praecox	2
Anthoxanthum odoratum	4
Festuca rubra	5
Holcus lanatus	1
Other vascular plants	
Achillea millefolium	3
Aphanes inexspectata	3
Carex hirta	2
Galium saxatile	5
Hypericum humifusum	1
Lotus corniculatus	2
Luzula campestris	4
Ornithopus perpusillus	2
Pilosella officinarum	5
Potentilla erecta	2
Rumex acetosella	5
Senecio jacobaea	1
Stellaria graminea	1
Trifolium dubium	2
Veronica arvensis	1
Veronica serpyllifolia	1
Mosses	
Pseudoscleropodium purum	3

Total number of species = 22
Quadrat size = $4m^2$
Vegetation height = 1cm
Management: heavily deer grazed.

A stand of U1 with elements of both U1d and U1e present. Presumably on less stressed soils than the U1a stands.

Hatch Park SSSI
U1e: Quadrat 6
Date of survey: 29/4/97

Species	Domin
Grasses	
Agrostis capillaris	4
Festuca filiformis	6
Holcus lanatus	2
Other vascular plants	
Galium saxatile	6
Luzula campestris	2
Rumex acetosella	4
Mosses	
Ceratodon purpureus	3
Dicranum scoparium	5
Pleurozium schreberi	6
Pseudoscleropodium purum	4

Total number of species = 9
Quadrat size = $4m^2$
Vegetation height = 1cm
Management: heavily deer grazed.

A stand of U1e with a thick springy turf.

Hatch Park SSSI **U1a: Quadrat 4** Date of survey: 29/4/97	
Species	**Domin**
Grasses	
Agrostis capillaris	3
Aira praecox	3
Festuca filiformis	4
Holcus lanatus	2
Other vascular plants	
Rumex acetosella	4
Mosses	
Polytrichum juniperinum	6
Lichens	
Cladonia c. cervicornis	3
Cladonia chlorophea	2
Cladonia ciliata	8
Cladonia coniocraea	3
Cladonia foliacea	2
Cladonia furcata	2
Coelocaulon aculeatum	3

Total number of species = 13
Quadrat size = 4m^2
Vegetation height = 0-1cm
Management: heavily rabbit & deer grazed.

On south face of sand pit, a lichen dominated sward with *Cladonia ciliata* dominant and *Cladonia foliacea* and *Coelocaulon aculeatum* present. Lacks *Cladonia arbuscula* but best described as U1a.

Hatch Park SSSI **U1b: Quadrat 5** Date of survey: 29/4/97	
Species	**Domin**
Grasses	
Agrostis capillaris	2
Aira praecox	3
Danthonia decumbens	2
Festuca filiformis	5
Holcus lanatus	3
Nardus stricta	1
Other vascular plants	
Rumex acetosella	6
Mosses	
Dicranum scoparium	7
Hypnum jutlandicum	2
Polytrichum juniperinum	5
Lichens	
Cladonia chlorophea	1
Cladonia ciliata	1
Cladonia foliacea	1

Total number of species = 11
Quadrat size = 4m^2
Vegetation height = 0-1cm
Management: heavily rabbit & deer grazed.

Moss-dominated U1b sward with low lichen cover and *Nardus* and *Danthonia* present. *Galium saxatile* absent.

11. Suffolk: Natural Area 46, Breckland

Lakenheath Warren SSSI (TL7680) - heathland - U2a, SD10b

This site was surveyed by Smith (1996), in August 1995. The relatively late timing of the survey and the effect of drought means that the floristic diversity may have been underestimated, particularly in U1 communities. The site has a wide range of acid grassland and heath communities intermixed with calcareous grassland. Types include U1a, U1b and U1d, H1 (*Calluna vulgaris - Festuca ovina* heath) SD10b and extensive stands of U2a (total of 150.8ha). The site has had varied history of management, including sheep grazing. Long-established trees and scrub suggest low grazing levels at times. Rodwell (1992) suggests that *Deschampsia flexuosa* has recently become locally prominent on Breckland grass heaths. Smith (1996) notes that the grass was particularly prominent in U1, H1 and SD10 at Lakenheath and may have overwhelmed other areas, resulting in the current large areas of U2a. In places these areas contain tussocky *Deschampsia flexuosa* with a reminant lichen carpet, possibly indicating succession from U1a, H1a or SD11a. Possible causes of spread of *Deschampsia flexuosa* are listed as reduction in numbers of rabbits due to myxomatosis, irregular sheep grazing regimes or atmospheric deposition of nitrogen. A constancy table based on 22 quadrats (2x2m) taken from U2a are reproduced below. The community at Lakenheath is described as long, coarse, tussocky grassland dominated by *Deschampsia flexuosa*, with *Festuca ovina*, *Hypnum cupressiforme*, *Pleurozium schreberi* and *Rumex acetosella* the only other constant species. A constancy table from 10 quadrats taken from SD10b is also given below. This community is also coarse and tussocky and is overwhelmingly dominated by *Carex arenaria*. Only *Festuca ovina* and *Holcus lanatus* are constant but their abundance is low. Lichens are very sparse.

Lakenheath Warren SSSI
Constancy table for U2a
Date of survey: 8/95

Species	Frequency	Domin
Deschampsia flexuosa	V	4-10
Festuca ovina	V	2-8
Hypnum cupressiforme	V	2-6
Pleurozium schreberi	IV	2-7
Rumex acetosella	IV	1-3
Agrostis capillaris	III	2-4
Dicranum scoparium	III	2-5
Pseudoscleropodium purum	III	2-6
Carex arenaria	III	2-3
Holcus lanatus	II	1-2
Poa pratensis	II	2
Ceratodon purpureus	II	1-2
Galium saxatile	II	1-3
Rhytidiadelphus squarrosus	II	2-5
Pteridium aquilinum	II	2-8
Galium verum	I	1-3
Polytyrichum juniperinum	I	2-5
Agrostis canina	I	2

Species	Frequency	Domin
Campanula rotundifolia	I	1
Anthoxanthum odoratum	I	2
Urtica dioica	I	1
Calluna vulgaris	I	2
Cladonia arbuscula	I	2
Cirsium vulgare	I	1-2
Juncus squarrosus	I	1
Arrhenatherum elatius	I	1
Veronica chamaedrys	I	1
Hyclomium splendens	I	2
Campylopus introflexus	I	3-5
Polytrichum piliferum	I	2
Teucrium scorodonia	I	1-2
Brachythecium albicans	I	2
Brachythecium rutabulum	I	2
Bare ground	III	1-3

Number of species per sample = 5-18
Average number of species per sample = 8.9
Additional species (DAFOR abundance): *Chamerion angustifolium* R, *Pinus sylvestris* O, *Crataegus monogyna* O, *Cerastium arvense* O, *Calamagrostis epigejos* R

Lakenheath Warren SSSI
Constancy table for SD10b
Date of survey: 8/95

Species	Frequency	Domin
Carex arenaria	V	8-10
Holcus lanatus	IV	2-6
Festuca ovina	IV	2-4
Deschampsia flexuosa	III	2-3
Senecio sylvaticus	III	2-3
Poa pratensis	III	2-3
Brachythecium rutabulum	I	1
Agrostis capillaris	I	2
Anthoxanthum odoratum	I	2
Galium verum	I	1-2
Koeleria macrantha	I	1
Urtica dioica	I	2
Teucrium scorodonia	I	3
Pteridum aquilinum	I	2-5
Luzula campestris	I	2
Arrhenatherum elatius	I	2
Bare ground	I	2

Number of species per sample = 3-8
Average number of species per sample = 5.3
Additional species (DAFOR abundance): *Cirsium arvense* O

12. Sussex (East): Natural Area 74, South Downs

Burnthouse Down West (TQ31) - Clayton to Offham Escarpment SSSI - acid grassland on drift over chalk - U4b

Fragments of acid grassland are occasionally recorded in chalk and limestone areas where there are patches of superficial deposits. The following two quadrats were taken from a site surveyed by Graham Steven and Nicola Muggeridge (Steven and Muggeridge 1992). The 1.8 ha of acid grassland at Burnthouse Down West occurs on the summit of a north-facing scarp face. The scarp face has a species rich complex of calcicolous grassland communities: CG3a, CG3c, CG2b, CG2c, CG3b, CG4b and CG2a (in order of decreasing abundance). The quadrats were identified as U4a using MATCH but the presence of *Holcus lanatus, Achillea millefolium, Cerastium fontanum* and *Dactylis glomerata* and the lack of strongly calcifuge species actually puts them much closer to U4b in phytosociological terms. In the description *Rumex acetosella* is also mentioned as occuring in the community, so U1e is likely to be present in drier areas. The site is lightly grazed by sheep and rabbits.

Burnthouse Down West
U4b: Quadrat data
Surveyed 2/8/91

Species	Domin (Q8)	Domin (Q9)
Grasses		
Agrostis capillaris	3	2
Anthoxanthum odoratum	3	2
Dactylis glomerata		1
Festuca ovina	7	6
Festuca rubra		2
Holcus lanatus	5	4
Koeleria macrantha	1	
Other vascular plants		
Achillea millefolium	4	3
Campanula rotundifolia		3
Centaurea nigra	1	
Cerastium fontanum	2	
Galium saxatile		8
Luzula campestris		4
Plantago lanceolata	5	
Potentilla erecta	5	6
Rumex acetosa	4	3
Mosses		
Pseudoscleropodium purum	2	
Species total Quadrat size Vegetation height (cm)	12 1m^2 3	12 1m^2 3

ENGLISH
NATURE

A review of the extent, conservation interest and management of lowland acid grassland in England

Volume II: County descriptions

No. 259 - English Nature Research Reports

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English Nature Research Reports

Number 259

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N.A. Sanderson
(Ecological Planning and Research)

ISSN 0967-876X
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A review of the extent, conservation interest and management of lowland acid grassland in England

Volume II

English Nature Contract VT2.1C

Commissioned from Ecological Planning & Research
129 Andover Road
Winchester
Hants SO22 6AY

Main Author
N.A. Sanderson BSc MSc

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1. Introduction

This volume describes the general distribution of lowland acid grassland on a county by county basis. All English counties are included and are described in alphabetical order except for Cleveland, Durham, Northumberland and Tyne and Wear which are amalgamated under the single heading of North East England, and East and West Sussex which are combined under the heading of Sussex. The county boundaries used in the review pre-date the 1997 local government re-organisation.

A description of the type of information summarised under each heading in the county accounts is given in Appendix 1 of this volume, along with an explanation of the fields in the county spreadsheets (Appendix 2). The Local Team staff and others consulted about each county are listed in Appendix 3 and the questionnaire on which the consultations were based is given in Appendix 4. The accounts also incorporate the contractor's own experience and observations.

Note: The following maps, which are in Volume I, are referred to throughout the county accounts.

- Maps 1a, 1b, 1c, 1d, 1e, 1f: Soil associations in which acid soils dominate, shown using old Natural Areas (1996) boundaries.
- Maps 2-4: Distribution of lowland acid grassland plant species listed in **Table 1**.
- Maps 5-7: Distribution of plant species of ephemeral ponds associated with acid grassland.
- Maps 8-10: Distribution of plant species associated with disturbed sandy soils.
- Maps 11-13: Distribution maps of *Carex arenaria Agrostis curtisii* and *Viola lutea*.
- Map 14: Old Natural Area boundaries (1996) used for Maps 1a-1f.
- Map 15: New Natural Area boundaries (1997).

Extracts from **Table 6** (in Volume I) are given in most county accounts in Volume II. Other Tables referred to in the text are also to be found in Volume I.

The Inventories referred to throughout Volume II are:

ENGLISH NATURE. 1992-1996. *The Grassland Inventory*. Peterborough: English Nature (46 volumes).

ENGLISH NATURE AND THE ROYAL SOCIETY FOR THE PROTECTION OF BIRDS. 1994-1996. *The Lowland Heathland Inventory*. Peterborough: English Nature (19 volumes).

2. Avon

2.1 Physical

Geology

The area has a complex geology with outcrops of hard Carboniferous limestones and sandstones outcropping through soft Triassic mudstones and Jurassic Lower Lias deposits.

Soils

The soil map shows that no soil associations dominated by podzols or brown sands occur in the county (Map 1c). Shallow limestone soils and calcareous clays are widespread.

2.2 Landscape history

19th Century

In the early 19th century a scatter of small commons existed north of the River Avon, many of which still survive in some form. To the south of the river there were extensive commons on the limestone hills, of which only Felton Common survives.

Current landscapes and Natural Areas

The county is largely within by the Bristol Avon Ridges and Valleys Natural Area (62) which is based on the area of great geological diversity north of the Mendips. This Area includes Bristol and is much affected by urban expansion, but still includes patches of important habitat, eg in the Avon Gorge and in the Gordano Valley.

Small unenclosed commons still survive in the more rural parts of the county. Some of these are on acid soils, lying on drift over limestone and Carboniferous sandstone, and can support acid grassland (Hedley & Aitchison, 1991). Avon also includes parts of the Severn and Avon Vales (56), Cotswolds (55), Somerset Levels and Moors (85) and the Mendip Hills (24) Natural Areas. In the latter Natural Area some areas of limestone are capped with acidic soils.

2.3 Existing information

Flora

A small concentration of the acid grassland species listed in **Table 1** is recorded by the coincidence maps (Maps 2-4), centred on grid squares ST56 and 66. The Flora of Somerset (Roe, 1981) covers the southern part of Avon but is not very informative for the county. Examination of the distribution maps indicates that about 14 characteristic species have been recorded from Avon, with four not recorded recently (**Table 6** & relevant extract given below).

Habitat surveys

The Grassland and Heathland Inventories indicate small areas of acidophilous vegetation on the Mendip Hills (NA84) and in the Bristol Avon Ridges and Valleys (NA62). Many of these are described in Biological Surveys of Common land (Hedley & Aitchison, 1991 & Hedley & Aitchison, 1992).

Biological survey of common land. No 21 (Hedley & Aitchison, 1991)

The common land survey recorded 33.79ha of unimproved acid grassland, representing 3% of the area of common land as opposed to 0.03% of the county. All of this was regarded as parched acid grassland (Festuca-Agrostis-Rumex grassland, U1).

The survey also recorded 54.88 ha of semi-improved acid grassland; 42.29 ha of this total was recorded from Westerleigh Common (CL60) (ST700820) which from the description, appears to be mostly Lolium-Cynosurus Grassland Anthoxanthum sub-community MG6b. Much of the rest does appear to be acid grassland, meaning that approximately 50ha of the acid grassland present in Avon occurs on commons.

There are two main areas where acid grassland has been recorded; small patches east of Bristol on commons over Carboniferous sandstone, and on commons to the south. The former group are centred on Siston Common (CL29) (ST665744) and contain small patches of what appear to be the Hypochaeris radicata sub-community (U1f) of U1 grassland. Species of interest noted include *Filago minima, Ornithopus perpusillus* and *Trifolium striatum.*

To the south, Felton Common (CL9) (ST520650) is a medium-sized common occurring on acid drift and limestone. The description and personal experience (N A Sanderson) suggest that this is Festuca-Agrostis-Galium grassland (U4) rather than parched acid grassland (U1). About 27ha of acid grassland has been recorded here.

Biological survey of common land. No 22 (Hedley & Aitchison, 1992)

On the southern boundary of Avon a large area of common land on the Mendips is registered in Somerset but is partly in Avon. This includes small areas of acid grassland, probably Festuca-Agrostis-Galium grassland (U4), on drift over limestone.

Summary of consultations with Local Team Conservation Officers

There has been a Phase I survey of Avon, carried out between 1986 and 1989, which recorded 39.6 ha of unimproved acidic grassland. Most of this is located in the centre of the county on the acidic Coal Measures. The figure does not include the small areas of acid grassland on drift over limestone found in those parts of the Mendips in Avon. Overall there is probably 50-100 ha of acid grassland in the county with the actual figure likely to be nearer 50 than 100 ha.

2.4 Summary of resource

Extent and composition

The area of acid grassland in Avon is likely to be very limited, and is probably not much over 50ha. This includes small stands of parched acid grassland (Festuca-Agrostis-Rumex grassland, U1) on commons lying over Coal Measure sandstones in the Bristol Avon Ridges and Valleys (NA62), and moist acid grassland (Festuca-Agrostis-Galium grassland, U4) on drift over limestone in the Mendip Hills (NA84).

Conservation value

The stands of U1 are probably still of some floristic interest at a county level and the acid grasslands on the Mendips are part of a limestone grassland complex of national value.

2.5 Future requirements for survey and conservation

Survey

There would appear to be no urgent requirements for acid grassland survey in the county.

Conservation

Personal observation suggests that the stands of U1 in the semi-urban commons west of Bristol will need active conservation if they are to survive the current lack of grazing, or under-grazing, which are allowing coarse vegetation to dominate.

2.6 References

HEDLEY, S. & AITCHISON, J. W. 1991. *Biological survey of common land No 21: Avon.* Peterborough: English Nature.

HEDLEY, S. & AITCHISON, J. W. 1992. *Biological survey of common land. No 22: Somerset.* Peterborough: English Nature.

ROE, R.G.B. 1981. *The flora of Somerset.* Taunton: Somerset Archaeological and Natural History Society.

Extract from Table 6 for Avon: occurrence plant species generally faithful to lowland acid grassland

County: Avon	
Natural Areas:	**All**
Chamaemelum nobile	0
Erodium maritimum	1
Filago minima	1
Hypochaeris glabra	0
Moenchia erecta	1
Ornithopus perpusillus	1
Potentilla argentea	0
Stellaria pallida	1
Teesdalia nudicaulis	1
Trifolium ornithopodioides	1
Trifolium scabrum	1
Trifolium striatum	1
Trifolium subterraneum	1
Viola lactea	0
Total no. of species extant	**10**
Total no. of species extinct	**4**
Total no. of species recorded	**14**

1 = Recent record
0 = Apparently extinct

Avon acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1984-91	Drift/calc, Common, Field	Small areas in NA 84 & 85	8	472.2	37.3	7.7		
Heathland Inventory		1983-94	Drift/calc, Common	Small areas in NA 84 & 85	5	269.0			13.3	
Commons Survey		1991	Drift/calc, Common	Covers much of known acid grssland	c8			c50		
Estimate, classes		1996		Neil Sanderson, EPR and Basil Greenwood, English Nature				B		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Commons	c23						c20					c30										
Estimate, class	A						A					A										

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000- 10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

3. Bedfordshire

3.1 Physical

Geology

Bedfordshire is dominated by Cretaceous and Jurassic limestones and clays, with acidic sands confined to the outcrop of the Lower Greensand that crosses the county from the south west to the north east. Drift deposits include glacial and river gravel and clay with flints, which may also give rise to acidic soils.

Soils

The brown sand-dominated soil associations closely follow the outcrop of the Lower Greensand (**Map 1d**).

3.2 Landscape history

19th Century

The 1830's 1 inch OS map shows that considerable Lower Greensand heathland had already been enclosed by the early part of the 19th century. However, some small areas of heath are marked, with the largest occurring at Sandy.

Current landscapes and Natural Areas

North of the Chalk of the Chilterns (NA 65) and East Anglian Chalk (NA 51) Natural Areas, the county is mostly part of the West Anglian Plain Natural Area (NA52), occurring on gently rolling Jurassic clays and limestones. The distinctive low Greensand ridge of the Bedfordshire Greensand Ridge Natural Area (NA53) still supports relics of the now enclosed Greensand heaths. Here only small areas of unimproved grassland and heathland have survived intensive agriculture and conifer planting.

3.3 Existing information

Flora

The coincidence map of the acid grassland species listed in **Table 1 (Map 2)** shows a significant concentration of such species on the Greensand Ridge but with high losses indicated by a comparison of the post-1970 map of scarce and rare species (**Map 4**) with the map of all records for these species (**Map 3**). The acid grassland species recorded are listed on **Table 6**, an extract from this table is given below. Dony (1976) in his Bedfordshire Plant Atlas shows that numerous species are confined, or nearly confined to the Greensand, including *Teesdalia nudicaulis, Cerastium semidecandrum, Trifolium striatum, Trifolium subterraneum, Ornithopus perpusillus, Potentilla argentea, Potentilla erecta, Aphanes inexspectata, Myosotis ramosissima, Plantago coronopus, Galium saxatile, Filago minima, Deschampsia flexuosa, Aira praecox* and *Aira caryophyllea*. *Rumex acetosella* is widespread off the Greensand on the Clay with Flints and gravels but other species are rare with a few records of species such as *Deschampsia flexuosa, Aira praecox, Galium saxatile* and *Potentilla erecta* on the Clay with Flints to the south.

Habitat surveys

The Grassland and Heathland Inventories indicate the occurrence of small areas of acid grassland and heath in the Greensand area. No other survey reports were obtained, but the distribution maps in the NVC Volume 3 show that sample quadrats of Festuca-Agrostis-Rumex typical sub-community (U1b) and Festuca-Agrostis-Rumex Galium-Potentilla sub-community (U1e) were recorded from the Greensand Ridge (Rodwell, 1992).

Summary of consultations with Local Team Conservation Officers

About 21.5ha of acid grassland have been recorded in SSSIs and 27ha in County Wildlife Sites (CWS). The area of acid grassland in the CWS is obtained from *Manual of wildlife sites and species protection* (Bedfordshire Wildlife Working Group 1995) and includes some areas noted as semi-improved. These areas probably include some neutral grassland. The total acid grassland resource for the county, which occurs in SSSIs and CWSs, is roughly estimated at 50ha.

Both parched acid grassland (Festuca-Agrostis-Rumex grassland, U1) and Wavy Hairgrass grass heath (Deschampsia flexuosa grassland, U2) are present in Bedfordshire, the latter as a matrix with heath. There is insufficient information available to estimate the proportion of these grassland types present.

The grassland is restricted to well-drained Greensand soils as either expanses of grassland (eg Maulden Heath) or mixed with heath. Much has been lost to both agriculture and plantations established on former acid grassland and heathland sites. Nau *et al* (1987) in *Bedfordshire Wildlife* (not seen by EPR) notes the best remaining acid grasslands are located in Maulden Heath and in the north-east area of Woburn Park.

Other than relics of enclosed heaths, some surviving acid grassland sites are parts of landscape parks, eg The Lodge, Sandy and Woburn Abbey. Substantial areas are also developing as a result of restoration proposals, eg Sandy Heath Quarry (Redlands). Acid grasslands are also found at the periphery of sand pits and railway verges.

As well as the species indicated in Dony (1976), lawns of mosses and lichens occur in some areas with the mosses *Polytrichum* species, *Brachythecium albicans* and *Ceratodon purpureus* and the lichens *Cladonia coccifera* agg. and *Cladonia chlorophaea.* The nationally rare Proliferous Pink *Petrorhagia prolifera* occurs in acid grassland and disturbed ground on a disused railway track near Potton, and this is a special species of the Greensand Ridge.

Common Blue (*Polyommatus icarus*) and Small Copper Butterflies (*Lycaena phlaeas*) can be abundant and there are records for local bugs such as *Chorosoma schillingi* and the Bishops Mitre Shield Bug (*Aelia acuminata.*)

The sites are generally managed by cutting, while grazing appears to be rare. There are some uncontrolled fires on heathland sites and some sites suffer from unauthorised motor biking.

3.4 Summary of resource

Extent and composition

The Bedfordshire Greensand clearly once supported extensive heathlands and acid grasslands with a fairly rich acid grassland flora. However, unimproved acid grassland has now been reduced to an estimated total of less than 50ha. The limited existing data suggests that the sub-communities U1b, U1e and U2a are present.

Conservation value

Despite the reduction in extent and richness of the Greensand heathlands and grasslands they are clearly still important in a county context. However, habitat loss has reduced their national significance.

3.5 Future requirements for survey and conservation

Survey

The English Nature Local Team considers that Phase 2 survey of the acid grasslands of the Greensand Ridge, particularly of non-statutory sites, would be valuable, to assess the full importance and extent of this resource.

Conservation

The Greensand Ridge is a clear priority for habitat restoration to counteract past fragmentation and habitat destruction.

3.6 References

DONY, J.G. 1976. *Bedfordshire plant atlas.* Luton: Borough of Luton Museum & Art Gallery.

BEDFORDSHIRE WILDLIFE WORKING GROUP. 1995. *Manual of wildlife sites and species protection - Bedfordshire.*

NAU, B.S., BOON, C.R. & KNOWLES, J.P. (eds.) 1987. *Bedfordshire wildlife.* Ware: Castlemead Publications.

Extract from Table 6 for Bedfordshire: occurrence of plant species generally faithful to lowland acid grassland

County: Bedfordsire	
Natural Areas:	53
Filago minima	1
Hypochaeris glabra	0
Moenchia erecta	0
Ornithopus perpusillus	1
Potentilla argentea	1
Stellaria pallida	1
Teesdalia nudicaulis	1
Trifolium striatum	1
Trifolium subterraneum	1
Vicia lathyroides	1
Total no. of species extant	**8**
Total no. of species extinct	**2**
Total no. of species recorded	**10**

Natural Area 53 = Bedfordshire Greensand Ridge
1 = Recent record
0 = Apparently extinct

Bedfordshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1984-90	Enclosure relic, Park, Field	All in the Greensand Ridge NA	5	246.9	16.2	7.0		
Heathland Inventory		1995	Enclosure relic, Park	All in the Greensand Ridge NA	13	626.0			112.9	
Estimates, ha		1996		Tim Barfield, EN. All in the Greensand Ridge NA				48.5		
Estimates, classes		1996						A		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Estimates, ha																						
Estimates, class	A		A			A		A	A													

Key

Column headings

GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates

A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000- 10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

4. Berkshire

4.1 Physical

Geology

Berkshire is dominated by the Tertiary deposits of the Thames Basin to the south and east, with Chalk outcrops of the Lambourn Downs to the north west. In the Thames Basin the heathland areas tend to be associated with the younger sands and clays above the London Clay, and the gravel terraces that cap the hill tops.

Soils

The heathland areas of the south east and the ridge tops in the rest of the Thames Basin stand out on the soil map with soil associations dominated by Podzols (**Map 1b**)

4.2 Landscape history

19th Century

The Thames Basin outside of the south east was countryside where small to medium size commons with heathland vegetation were frequent on the less fertile soils. In the south east the landscape was dominated by the immense heathlands of Windsor Forest.

Current landscapes and Natural Areas

Berkshire is dominated by two Natural Areas; the chalk Downs of the north west are included within the Berkshire and Marlborough Downs (NA79) and the Tertiary deposits are in the London Basin (NA66). The latter encompasses the two distinct areas, referred to above in the description of the 19th century landscape. In both Natural Areas, enclosure of heathland and general neglect of the surviving areas has resulted in massive losses of heath and associated acid grassland. Some areas of heathland have survived because of their use for military purposes.

4.3 Existing information

Flora

The coincidence map (**Map 2**) of all records of the acid grassland species listed in **Table 1** shows the Thames Valley to have been be rich in these species, especially to the south. However, losses have been severe as shown in **Map 3** and **Map 4**. One notable feature is the survival of *Viola lactea* on Inkpen Common (SU3864) a heathland relic that is now cattle-grazed. Numbers of acid grassland species in Berkshire are given in the extract of **Table 6** below.

Fauna

The short, mown, acid grassland of Greenham Common air base is part of a large area of open habitat which has supported breeding Lapwing and possibly Stone Curlew and Little Ringed Plover (Ecological Planning & Research, 1995).

Habitat surveys

The Grassland Inventory records only 3 sites including two large sites at Greenham Common (SU4964) and Windsor Forest (SU97). The Heathland Inventory records about 50 ha of dry heath in the south and south east of the county. Five habitat surveys have recorded acid grassland. English Nature's chalk grassland data set indicates that 4.6 hectares of neutral/acid grassland (MG/U) was record on the downland in the south west of the county at Inkpen Hill (SU3761). More specific data on acid grassland was found in the following surveys.

Biological survey of common land No 14: Berkshire (Francis et al, 1990)

This survey recorded over 100ha of acid grassland and mosaics of acid grassland with dry heath. Most of it was recorded within the Greenham Common complex, with small areas elsewhere in central southern Berkshire. The descriptions indicate that parched acid grassland (Festuca-Agrostis-Rumex grassland, U1) dominates but with some Deschampsia flexuosa grassland (U2).

Greenham Common reports (Porley, 1993 & Ecological Planning & Research, 1995)

This important site includes both mown acid grassland and heath within the former air base and more overgrown heathland beyond. A detailed NVC survey has been carried out over part of the site and a management plan has been written for the whole site. The acid grassland is especially varied and species rich, dominated by U1 dominating with several sub-communities recorded (U1b, U1d, U1e & U1f). The flora is the richest for acid grassland species in Berkshire with species such as *Moenchia erecta*, *Filago minima* and a large number of calcicole species such as *Carlina vulgaris* and *Hippocrepis comosa* occurring in the U1d communities. The latter species appear to have been favoured by the presence of lime-rich concrete runways. It is intended to reinstate grazing on these commons once they have been restored after military use.

Windsor Great Park (Steven, 1995)

This grassland survey recorded about 30 ha of unimproved acid grassland within the parkland of Windsor Great Park with its internationally important concentration of veteran trees. Moist acid grassland (Festuca-Agrostis-Galium grassland, U4) preominates, but from the data provided it appears that parched acid grassland (U1e) is also present. Selected data from the survey are presented in Volume I (Appendix I) as an example of U4 grassland in a parkland landscape.

The grassland is fragmented and is mown, not grazed, but represents a large proportion of the total acid grassland resource in Berkshire. A small area of turf stripping has produced more diverse acid grassland from species poor grassland. The resumption of grazing by cattle is recommended.

Summary of consultations with Local Team Conservation Officers

It was confirmed that Greenham Common and Windsor Forest, described above, are the most important sites for acid grassland in the county; the former for its parched acid grassland communities with a rich associated flora and the latter, although less diverse, for its unusual stands of U4 grassland on the London Clay.

Ted Green, the former EN warden at Windsor has found the unimproved grasslands at Windsor to be rich in both grassland and mycorrhizal fungi, the latter associated with the veteran trees occurring in the grassland. The best conditions for the fruiting of these fungi is a very short sward, with rabbit grazing producing ideal conditions. The neighbouring improved grasslands are poor in fungi species.

Beyond these major sites the area of acid grassland is limited. Small fragments of U1 and U2 are found in relic heathlands and on the gravelly parts of flood plains. The best example of the latter type of habitat is found in Sulham and Tidmarsh Hoods and Meadows SSSI (SU635741) where 2ha of U1 grassland with *Ulex minor* occurs. It is estimated that there is about 150ha of acid grassland in Berkshire of which about 30ha is U2 grassland, 30ha is U4 grassland, and the rest is U1 grassland.

4.4 Summary of resource

Extent and composition

There has clearly been a massive reduction in the area of acid grassland in Berkshire and most acid grassland sites consist of small fragments. There are however, two large sites surviving; Greenham Common and Windsor Forest. The former contains very diverse U1 grassland and the latter is dominated by U4.

Conservation value

Greenham Common is a site of major nature conservation interest where disturbance and mowing has maintained acid grassland similar to that seen in parts of the New Forest, and it is one of the best individual sites in southern England. The grassland in Windsor Park forms part of the habitat of an internationally important assemblage of veteran trees.

4.5 Future requirements for survey and conservation

Survey

As both Greenham Common and Windsor Park have been surveyed, additional survey and floristic assessment of other acid grasslands in the London Basin are of moderate priority.

Conservation

The main requirement in Berkshire would appear to be a vigorous programme of heathland restoration, including introduction of extensive grazing. Much restoration is already under way or planned.

4.6 References

ECOLOGICAL PLANNING & RESEARCH. 1995. *Greenham Common management plan.* Newbury: Newbury District Council.

FRANCIS I.S., PENFORD, N., AITCHISON, J.W. & MASTERS, S. 1990. *Biological survey of common land No 14: Berkshire.* Peterborough: English Nature.

PORLEY, R.D. 1993. *A botanical survey and assessment of Greenham Common airbase, Berkshire.* Newbury: English Nature, South Region.

STEVEN, G. 1995. *Windsor Great Park. An assessment of the conservation value of the grassland.* Newbury: English Nature, Thames and Chilterns Team.

Extract from Table 6 for Berkshire: occurrence of plant species generally faithful to lowland acid grassland

County: **Berkshire**	
Natural Areas:	**66**
Chamaemelum nobile	1
Dianthus deltoides	0
Filago minima	1
Hypochaeris glabra	0
Moenchia erecta	1
Ornithopus perpusillus	1
Potentilla argentea	1
Sagina subulata	1
Stellaria pallida	1
Teesdalia nudicaulis	1
Trifolium ornithopodioides	0
Trifolium scabrum	0
Trifolium subterraneum	1
Viola lactea	1
Total no. of species extant	**10**
Total no. of species extinct	**4**
Total no. of species recorded	**14**

66 = London Basin

1 = Recent record
0 = Apparently extinct

Berkshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1983-94	Heath, Flood plain, Parkland	Excludes many heathland sites	3	208.6	100.0	100.0		
Heathland Inventory		1991-93	Heath, Enclosure relic	Mainly in south and south west of the county	30	3290.0			53.2	
Common Land		1990	Heath	Greenham plus other commons in SW, 1 to NE				116.0		
Chalk Grassland	SU374614	1985	Calcicolous/drift	MG/U recorded from downland site, Inkpen		10.8	6.5	6.5		
Greenham (Porley, 1993)	SU495646	1993	Heath	Mosaic of H2 & U1, only part of common surveyed				27.0		
Greenham (EPR, 1995)	SU495646	1995	Heath	Not full survey as still under military ownership						
Widsor (Steven, 1995)	SU97	1994-5	Parkland	Descriptions indicate U4 dominant plus U1e	1			31.7		
Estimate, hectares		1996	Above	Graham Steven, EN				150		
Estimate, class		1996		Graham Steven, EN				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Common Land	+							+														
Greenham 93	27.0		+		+		+															
Greenham 95	50.0		+		+	+	+	0.5	0.5													
Windsor 95	+					+			+			+	+									
Estimate, ha	90.0							30.0	30.0			30.0	30.0									
Estimate, class	B		A		A	A	B	A	A			A	A									

Key

Column headings

GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland

H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub communities

Area estimates

A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha

F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

5. Buckinghamshire

5.1 Physical

Geology

Buckinghamshire spans a range of rock types from a small area of Tertiary clays and sands in the south east corner, through the Chalk of the Chilterns and Jurassic clays and limestones beyond. A small area of Lower Greensand outcrops on the western boundary. This is contiguous with the Greensand of Bedfordshire. Deep clay with flint deposits exist on the Chalk of the Chilterns.

Soils

Soil associations dominated by dry acidic soils are rare on the soil map. A soil association dominated by brown sands is recorded in the Greensand Ridge Natural Area (NA 53) (**Map 1c**).

5.2 Landscape history

19th Century

In the early 19th century large commons of rough grazing or pasture woodland were a feature of the hill tops in the south of the county.

Current landscapes and Natural Areas

The north of the county includes part of the West Anglian Plain Natural Area (NA52) and the Thames and Avon Vales Natural Area (NA63) where Jurassic clays are predominant and acidic soils are rare. The Midvale Ridge Naural Area (NA64) probably once had acid grasslands on leached soils derived from sandy Corallian Limestone. In the east a small area of the Greensand Ridge, which is dominated by acid soils (NA53), just extends into the county while in the south the clay cap on the chalk downs of the Chilterns (NA65) support some acid soils. Both of these Natural Areas in Buckinghamshire, however, now have few areas of surviving unimproved acid grassland. The county also includes a corner of the London Basin Natural Area (NA66) where acidic soils are frequent and where some significant heathland relics and pasture woodlands survive.

5.3 Existing information

Flora

Other than in the extreme south east of the county in the London Basin and possibly the Greensand Ridge, the lowland acid grassland species listed in **Table 1** are almost completely absent from Buckinghamshire (**Map 2**). The post-1970 records of selected species (**Map 4**) compared to all records of these species on **Map 3** indicate considerable losses from the limited areas from which acid grassland species have been recorded.

Habitat surveys

The Grassland Inventory records only two sites with acid grassland, both of which occur on drift over the Chalk in the Chilterns. The Heathland Inventory indicates small areas of heathland surviving at Stoke Common (SU9885) and Burnham Beeches (SU9585) and a tiny fragment on the Greensand Ridge.

Summary of consultations with Local Team Conservation Officers

Very little acid grassland is known in Buckinghamshire. Some acidic grassland occurs on thick drift on Coombe Hill (SP849066) above the chalk scarp of the Chilterns but the NVC type is not known. On the dip slope of the Chalk, 1.2ha of moist acid grassland (Festuca-Agrostis-Galium grassland, U4) has been recorded at Moorend Common (SU802905). The heathland and pasture woodlands in the south east, including Burnham Beeches and Stoke Common, probably contain less than 10ha of *Deschampsia flexuosa* grass heath (U2a). In 1996 some remnant acid grassland was discovered on the Greensand close to Kings and Bakers Woods and Heaths SSSI. This is apparently semi-improved but is a large area (14ha). It has not been included in the statistics for the county.

5.4 Summary of resource

Extent and composition

Only extremely small areas of acid grassland remain. NVC communities U4 and U2 certainly survive. Parched acid grassland (U1) must have occurred in the London Basin and the Greensand Ridge and tiny fragments still probably survive in disturbed areas.

Conservation value

The remaining areas of acid grassland are of limited significance other than at a county level. The small area of the London Basin in the county, however, should be regarded as part of the more significant assemblage of acid grasslands of this Natural Area.

5.5 Future requirements for survey and conservation

Survey

There is no obvious requirement for Phase 2 surveys other than in the Greensand Ridge which should be covered by any survey undertaken for the Bedfordshire part of this Natural Area.

Conservation

Restoration of grazing to heathland and pasture woodland in the London Basin and the Greensand Ridge would undoubtedly allow the recovery of significant areas of acid grassland. Such restoration is already under way at Burnham Beeches.

Buckinghamshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1987-93	Calicicolous/drift, Common	Small areas on superficials on chalk, Chilterns	2	8.2	6.5	1.2		
Heathland Inventory		1984-95	Above + Heath & Pasture wood	Above + most in NA66 & tiny area in NA53	8	572.0			89.8	
Estimates, hectares		1996		Graham Steven, EN				<10		
Estimates, classes		1996		Graham Steven, EN				A		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Estimates, Ha								<10				1.2										0.0
Estimates, class								A				A										

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

6. Cambridgeshire

6.1 Physical

Geology

The solid geology of Cambridgeshire is simple, with bands of progressively older rocks from the Chalk in the southeast, to Oolitic limestones in the north west. In between Jurassic and Cretaceous clays are dominant. A narrow band of Lower Greensand crosses the county but this is mostly obscured by drift. Much of the county is in fact covered by thick drift including boulder clay, alluvium, peat and limited amounts of glacial sands and gravels.

Soils

Boulder clay, alluvial and chalk and limestone soils occupy most of the county but soil associations dominated by brown sands do occur around Gamlingay on the Lower Greensand in the east, an extension of the Bedfordshire Greensand outcrop. The blown sands of Breckland also just penetrate the county in the east around Kennet and Chippenham to Newmarket Heath, where there are polygons and stripes (**Map 1d**).

6.2 Landscape history

19th Century

On the 1830's 1 inch OS map, Gamlingay Heath is marked as still unenclosed with the valley mires specifically shown. In the east, Kennet Heath still existed, although by then in a generally enclosed countryside.

Current landscapes and Natural Areas

The county is dominated by the West Anglian Plain (NA52) and the Fens (NA37) Natural Areas which are unlikely territory for acid grassland. To the south the East Anglian Chalk Natural Area (NA51) also has limited potential for acid grassland but small areas of Breckland (NA46) and the Bedfordshire Greensand Ridge (NA53) Natural Areas just enter the county and both contain areas of soil associations dominated by brown sands. However in the Cambridgeshire part of these two Natural Areas in there is very little semi-natural vegetation left.

6.3 Existing information

Flora

The coincidence maps of the lowland acid grassland species listed in **Table 1** (**Maps 2** to **4**) show high concentrations of these species on the acid soil areas on the eastern and western boundaries of the county. However, significant numbers of species have also been recorded from parts of the East Anglian Chalk (NA51). Post-1970 records indicate losses but there are still clusters of acid grassland species recorded.

Two fairly recent floras covering the historic county have been published; Perring *et al* (1964) and Crompton & Whitehouse (1983). The first is a traditional flora, lacking dot maps but with a useful account of the flora, while the latter is a more up-to-date check list. The county largely lacks any acid grassland but small areas near the county boundaries support, or have supported a rich flora. These include a small corner of Breckland in grid squares TL66, 67 and 67, the eastern end of the

Bedfordshire Greensand in TL25 and a small area of glacial gravels at Hildersham, the 'Furze Hills' in TL54.

Perring *et al* (1964) note that Breckland type vegetation only survived around the edges of sand pits around Chippenham and Kennett. Many typical Breckland species have been recorded including *Apera interrupta, Filago minima, Herniaria glabra, Medicago minima, Ornithopus perpusillus, Potentilla argentea* and *Silene conica* but several including *Crassula tillaea* and *Teesdalia nudicaulis* have not been seen for years (Crompton & Whitehouse, 1983). The Hildersham 'Furze Hills' are described as providing a famous, isolated, locality for Breckland species including *Dianthus deltoides.*

The Greensand area around the village of Gamlingay before the 1850's included well-developed heathland, with rich valley mires as well as drier habitats. In this century only small fragments of acid grassland survive but these are recorded as supporting *Trifolium subterraneum* as well as commoner acid grassland species. *Moenchia erecta* has been recorded in the past but not recently (Crompton & Whitehouse, 1983). The Soke of Peterborough has very few records for acid grassland species (Gent & Wilson, 1995).

The acid grassland species listed in **Table 1** that have been recorded from the county are listed in **Table 6**, from which the relevant data has been extracted below. The total number recorded is high (18 species) but there is also a high number of extinctions, with 5 species not recorded recently.

Habitat surveys

The Grassland Inventory records only two sites, Castor Hanglands (TF1101) and Furze Hill (TL5548), both SSSIs. The Heathland Inventory adds a tiny relic on the Greensand near Gamlingay. No other survey reports were obtained but the maps in the NVC Volume 3 show that at least one sample quadrat of Festuca-Agrostis-Rumex grassland Anthoxanthum-Lotus sub-community (U1d) was recorded from grid square TL56 (Rodwell, 1992).

Summary of consultations with Local Team Conservation Officers

The area of acid grassland in the county is now very small, probably between 1 and 10ha. In the East Anglian Chalk Natural Area (NA51) there are small areas of parched acid grassland (U1), in mosaics with calcicolous grassland on patchy drift at Furze Hill and at Newmarket Heath. The latter is usually regarded as a calcareous site but actually has a chalky/acid vegetation mosaic. The former site is rabbit grazed and has a lichen-rich areas (U1a); the latter site is mown. In the Greensand Ridge area small areas of U1 survive around Gamlingay (TL25).

The acid grassland recorded at Castor Hanglands is a tiny 0.5ha relic of about 1,000ha of heathland ploughed up earlier this century. This heathland originally included wet heath, dry heath, bracken and *Deschampsia flexuosa* grassland (U2). It now consists of two Heather *Calluna* plants in an acid grassland with *Carex pilulifera, Potentilla erecta* and *Rumex acetosella.* This grassland could be NVC community Festuca-Agrostis-Rumex Galium-Potentilla sub-community (U1e).

The Breckland area in the east of the county now contains no undisturbed acid grassland, but secondary sites with characteristic acid grassland species occur in old gravel pits and include species such as *Apera interrupta, Vulpia ciliata* and *Herniaria glabra.* These are fragmentary and none are SSSIs. These sites could conceivably include the rare Erodium-Teesdalia sub-community U1c.

6.4 Summary of resource

Extent and composition

Only a tiny proportion of the once rich acid grasslands in the Bedfordshire Greensand Ridge and Breckland Natural Areas in Cambridgeshire now survive.

Gravel works are of some importance in retaining something of the flora and small patches also survive with calcareous grasslands on shallow drifts. Furze Hill is the most floristically significant of these areas. Only U1 grasslands appear to be present in the county, with the sub-communities U1a, U1b, U1d and U1e probably present.

Conservation value

The conservation value of the surviving acid grassland is limited by its small area, but it is clearly significant in a county context.

6.5 Future requirements for survey and conservation

Survey

Any survey of the Greensand Ridge in Bedfordshire should include the Gamlingay area. The Kennet area should probably be included by on-going Breckland surveys.

Conservation

The Greensand Ridge and Breckland areas have a high priority for restoration of grassland from arable and mineral workings.

6.6 References

CROMPTON, G. & WHITEHOUSE, H.L.K. 1983. *A checklist of the flora of Cambridgeshire.* Cambridge: University Printing Services.

GENT, G. & WILSON, R. 1995. *The flora of Northamptonshire and the Soke of Peterborough.* Rothwell: Kettering & District Natural History Society & Northamptonshire Flora Group.

PERRING, F.H., SELL, P.D. & WALTERS, S.M. 1964. *A flora of Cambridgeshire.* Cambridge: Cambridge University Press.

Extract from Table 6 for Cambridgeshire: occurrence of plant species generally faithful to lowland acid grassland

County: Cambridgeshire	
Natural Areas:	**All**
Grasses	
Apera interrupta	1
Vulpia ciliata	1
Other Vascular Plants	
Crassula tillaea	0
Filago minima	1
Herniaria glabra	1
Hypochaeris glabra	0
Medicago minima	1
Moenchia erecta	0
Ornithopus perpusillus	1
Potentilla argentea	1
Silene conica	1
Stellaria pallida	1
Teesdalia nudicaulis	0
Thymus serpyllum	0
Trifolium scabrum	1
Trifolium striatum	1
Trifolium subterraneum	1
Vicia lathyroides	1
Total no. of species extant	**13**
Total no. of species extinct	**5**
Total no. of species recorded	**18**

1 = Recent record
0 = Apparently extinct

Cambridgeshire acid grasslands surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1989-90	Calcareous/drift	No sites recorded in the acid soil areas	2	95.2	0.8			
Heathland Inventory		1983-95	Calcareous/drift, Enclosure relic	Tiny relics	4	878.0			0.3	
Estimates, ha		1996	Above	Donna Radley EN				<10		
Estimates, classes		1996						A		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Estimates, ha																						
Estimates, class	A	A	?		A	A																

Key

Column headings

GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates

A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

7. Cheshire

7.1 Physical

Geology

The Cheshire Plain lies predominantly on Keuper Marl but the landscape is dominated by boulder clay and associated sandy glacial deposits. In the far east of the county the Pennine fringes are formed of Coal Measures and Millstone Grit.

Soils

The Cheshire Plain has ground water gley soils dominating over wide areas but with locally brown earths and podzols becoming dominant (**Map 1e**).

7.2 Landscape history

19th Century

The 1 inch OS maps of the 1830's show a scatter of heaths in a largely enclosed landscape.

Current landscapes and Natural Areas

Most of Cheshire is in the Mosses and Meres Natural Area (NA27), a heavily cultivated area with only limited patches of surviving acid grassland. The eastern fringes of the county include several more upland Natural Areas.

7.3 Existing information

Flora

The coincidence maps of the lowland acid grassland species listed in **Table 1** (**Maps 2** to **4**) show a rather limited acid grassland flora throughout Cheshire. Only five species appear to have been recorded from Cheshire in the Mosses and Meres Natural Area (NA27). The relevant data extracted from **Table 6** is given below.

Habitat surveys

The Grassland Inventory records quite a number of unimproved grasslands scattered across the Cheshire Plain and the Pennine fringes. All were in fields and many were in valleys. The Heathland Inventory similarly records a scatter of enclosure relics across the centre and east of the county. The maps in the NVC Volume 3 show that at least one sample quadrat of Festuca-Agrostis-Galium grassland Holcus-Trifolium sub-community (U4d) was recorded from the Cheshire Plain (Rodwell, 1992). Two Phase 2 survey reports have been produced covering the south west of the county.

Cheshire unimproved grassland and hay meadow search 1992-93 (Drage, 1992 & 1993)

This survey recorded several areas of acid grassland associated with neutral grassland and rush pasture, but is rather unclear on the types of acid grassland present. One unidentified stand (Old Castle Pastures, SU469447) appears to be an interesting example of Festuca-Agrostis-Rumex grassland Anthoxanthum-Lotus sub-community (U1d) but U1 is not mentioned in the report. Other stands are described as U4 grassland and appear to be less floristically interesting.

Summary of consultations with Local Team Conservation Officers

The Cheshire Plain has very little unimproved grassland, with intensive dairy production the dominant land use. To the east, acid grassland does occur in the Pennine fringes but is very upland in character and is not considered here.

Most lowland grassland occurs in the south west, often in valley sites where improvement is not easy. Neutral grassland (MG5) dominates but there is some acid grassland. The largest area is Tatton Park (SJ78), a deer park with rather semi-improved acid grassland. There is probably about 50-100ha of acid grassland in the county with U4 probably more frequent than U1. Sandstone ridges support relic heathland and here Deschampsia flexuosa grassland (U2) may occur.

7.4 Summary of resource

Extent and composition

The limited area of lowland acid grassland that occurs is mainly associated with patches of dry sandy soils within unimproved grasslands, and is associated with neutral grassland and fen meadows communities. Some parched acid grassland (U1) occurs but is not particularly floristically rich; U4 and U2 appear more typical of the acid grasslands of the county.

Conservation value

The main interest of acid grasslands in this county appears to be in their association with neutral grasslands rather than any intrinsic importance. The Wych Valley is the most impressive area of this type (Drage, 1992).

7.5 Future requirements for survey and conservation

Survey

There are no priorities for acid grassland surveys but Drage's work in the south west of the county could be followed up with floristic assessments.

Conservation

Stands of acid grassland associated with neutral grassland would appear to be the main priority for conservation.

7.6 References

DRAGE, J. 1992. *South-west Cheshire unimproved grassland and hay meadow search.* Shrewsbury: English Nature.

DRAGE, J. 1993. *West Cheshire unimproved grassland and hay meadow search.* Shrewsbury: English Nature.

Extract from Table 6 for Cheshire: occurrence of plant species generally faithful to lowland acid grassland

County: Cheshire	
Natural Areas:	**27 (part)**
Filago minima	1
Hypochaeris glabra	0
Ornithopus perpusillus	1
Potentilla argentea	1
Trifolium striatum	1
Total no. of species extant	4
Total no. of species extinct	1
Total no. of species recorded	5

27 = Mosses and Meres

1 = Recent record
0 = Apparently extinct

Cheshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1985-94	Fields, some in valleys	Most in NA27 but also NA28 & NA29	33	360.4	37.9	2.2		
Heathland Inventory		1984-94	Enclosure relics	Scattered across the county, except in the west	44	1550.0			54.9	
Drage (1992 & 93)		1992-93	Fields	Acid grassland recorded but identity not clear	34			c10		
Estimate, classes		1996		Chris Walker, English Nature				B		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Drage (92/93)	+				+							+										
Estimate, class	A				A			A				B										

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
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E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

8. Cornwall

8.1 Physical

Geology

The most distinctive features of Cornwall are the granite intrusions that underlie the higher ground and the Lizard, which has an unusual ultra-basic intrusion. Extensive mineralisation is associated with the granite intrusions. The Culm Measure shales extend into the north east of the county whilst the rest of the county is dominated by Lower Devonian sediments.

Soils

The granite outcrops support complexes of upland soils with ironpan stagnopodzols and humic brown podzolic soils. In the highly oceanic conditions found in Cornwall, these occur at much lower levels than are typical of such soils in less oceanic areas. Beyond these areas brown earths dominate, but with brown podzolic soils and brown rankers on valley sides (**Map 1a**).

8.2 Landscape history

19th Century

In the early 19th century large areas of the central 'spine' of Cornwall were still common land under heathland. Since then, beyond West Penwith, The Lizard and Bodmin Moor, where extensive areas of heathland or moorland still survive, most of this common land has been enclosed and improved.

Current landscapes and Natural Areas

Bodmin Moor (NA94), the highest granite outcrop, generally regarded as an upland area, West Penwith (NA96) and the unique Lizard (NA97), are recognised as individual Natural Areas in Cornwall by English Nature. Elsewhere the north east corner is included within the Culm Measures Natural Area (NA93) and the rest included within Cornish Killas and Granite Natural Area (NA95). The latter Area and West Penwith have distinctive landscapes on the granite outcrops. The Culm Measures Natural Area and the Cornish Killas and Granite Nature Area are dominated by improved grassland and suffered a high loss of unimproved grasslands and mires to agricultural improvement this century.

8.3 Existing information

Flora

The coincidence maps of lowland acid grassland species listed in **Table 1** (**Maps 2** to **4**) show a very high concentration of species along the south coast. This flora has declined but significant concentrations still exist. The flora is mostly composed of southern oceanic species and is similar to that of the south Devon coast. On the Lizard, acid grassland forms part of the complex of unique habitats that harbour many rare species, including clovers. The relevant data extracted from **Table 6** is given below.

An interesting RDB species is Toadflax-leaved St John's-wort *Hypericum linariifolium* which occurs at two sites in Cornwall. This plant is found on shallow rocky soils on south facing slopes, mainly on rock outcrops. These are mostly set in Ulex galllii-Agrostis curtisii heaths (H4) but the actual rock outcrops appear to carry U1 type vegetation (McDonnell, 1995)

West Cornwall also had a concentration of ephemeral pond species which appear to have suffered a decline in recent decades (**Maps** 5 to 7).

Habitat surveys

The Grassland Inventory shows that most acid grassland have been recorded during the surveying of wet *Molinia* grassland. The Heathland Inventory is probably more useful for indicating potential dry acid grassland locations by showing the distribution of heathland and heathland relics which are still frequent on the higher ground and on the coast.

Lock (1990) in an assessment of the plant communities on the mid-Cornwall moors, which lie largely between St Austell and Bodmin, reported that less than 25 ha of dry acid grassland occurred. It generally was found as very small patches on drier hummocks amongst wetland plant communities and on freely draining soils on the margins of the moors. Maps in the NVC Volume 3, show that U1e, U1f, U4a, U4b and U4e were sampled from the county (Rodwell, 1992).

Summary of consultations with Local Team Conservation Officers

Most of the acid grassland in Cornwall is found within Bodmin Moor where heavy grazing of heathland has extended its area to some extent. Bodmin Moor is regarded as being of upland character, falling into the social/land use definition of being within a Less Favoured Area and has significant areas above an elevation of 250m.

Beyond Bodmin it is difficult to estimate the area of acid grassland due to the lack of data. The extent of heathland enclosure and near universal improvement within enclosed fields, even within areas of small scale field patterns, means that it is unlikely to be a large area. A conservative estimate is between 100-500ha.

Moist acid grassland (Festuca-Agrostis-Galium grassland, U4) and *Agrostis curtisii* grass heath (U3) are widespread, whilst parched acid grassland is much more scarce, although species-rich stands exist on coastal cliffs. Most inland acid grassland is likely to be associated with heathland habitats.

Little information on the conservation value of acid grassland is available and there is concern that the role of acid grassland within the overall heathland ecosystem has not been adequately assessed.

Most of the plants which are regarded as being of interest on heathlands actually grow in wet and dry grasslands, examples being Heath Lobelia *Lobelia urens* in *Molinia* grassland, *Euphrasia vigursii* in Agrostis curtisii grassland (U3) and the nearly endemic Bladderseed *Physospermum cornubiense* which has a major stronghold on sloping acid grasslands associated with Bracken. In the lowlands the latter species occurs mainly on hedge banks but may once have occurred in lowland acid grasslands before enclosure. It was felt that acid grasslands would also have an important role in the ecology of heathland vertebrates and invertebrates but information is lacking.

One feature on which there is very little information are the steep grassy valley sides which frequently occur in Cornwall. These appear semi-improved with *Festuca-Agrostis* swards, often with Bracken. The conservation value of these in the wider countryside is unclear. Their topography means they are likely to have escaped ploughing or intensive grassland management.

The widespread mineral waste sites and derelict land, such as china clay tips and old railway lines, represent a second incompletely understood conservation resource in Cornwall. Acid grassland may be present in these habitats, which provide suitable conditions for species such as *Filago minima*. Such sites may have a lower plant interest and may have evolutionary and biodiversity value as they can contain examples of micro-evolution of plant species towards the development of heavy metal tolerance.

Bodmin Moor has problems with inappropriate grazing; the commons are frequently used as winter feed lots, which results in overgrazing. In the lowlands, however, undergrazing or lack of grazing is the more typical problem.

Simon Leach of English Nature is currently surveying the RDB plant *Lotus angustissimus* and has become aware of a species-rich type of the little known NVC community Festuca-Agrostis-Rumex grassland Hypochaeris sub-community (U1f), which occurs in small areas of thin droughty soil on coastal cliff tops. Associated with the *Lotus angustissimus* are species such as *Lotus subbiflorus*, *Trifolium glomeratum*, *Trifolium ornithopodioides*, *Trifolium scabrum*, *Moenchia erecta*, *Erodium maritimum* and *Erodium moschatum*. Quadrat data show there to be little *Festuca rubra* and no *Festuca ovina* and much *Vulpia bromoides*. A constancy table for U1f, based on quadrat data from the survey, is presented in Volume I, Appendix 1, to illustrate the richness of this cliff top acid grassland. The community is best developed from Start Point in Devon to Looe in Cornwall on the south coast, with pockets on the Lizard and Land's End. It is less well-developed on the north coast where south-facing slopes are rare. The coastal habitat where this community occurs is much degraded by the lack of grazing and spread of Gorse, and many stands are reduced to narrow bands along paths.

The Lizard coastal grasslands are unique in Britain and of exceptional importance but for the most part are true maritime grasslands (MC5) and outside the scope of this report.

8.4 Summary of resource

Extent and composition

Lowland acid grassland in Cornwall is a significant component of acid heathland and cliff top habitats. In the case of the latter it has recently been shown to be floristically species-rich with an important flora of southern oceanic affinities. The inland stands are an integral part of heathland ecosystems.

Conservation value

The small patches of coastal acid grassland (U1f) are, along with those in Devon, are amongst the most floristically important acid grasslands in the country. Otherwise acid grasslands in the county are best regarded as an integral and important part of heathland ecosystems. The Agrostis curtisii grasslands (U3) have an intrinsic rarity value in an international context.

8.5 Future requirements for survey and conservation

Survey

The remaining cliff top acid grassland resource requires assessment but otherwise Cornwall's requirements are more for ecological studies of the role of grasslands in heathland biodiversity.

Conservation

The main requirements are for the restoration of sustainable extensive pastoralism to the remaining relics of heathland and cliff top habitats and, where possible, their extension. The more upland stands of U3 are over-grazed, a more structured grassland would probably be of more value.

8.6 References

LOCK, L. 1990. *Analysis of the remaining resource of the mid-Cornwall moors.* Taunton: Nature Conservancy Council, South-West Region.

McDONNELL, E.J. 1995. 'Back from the brink project'. *The status of Toadflax-leaved St John's-wort* (Hypericum linariifolium Vahl) *in Britain 1994.* London: Plantlife Project Report No. 40.

Extract from Table 6 for Cornwall: occurrence of plant species generally faithful to lowland acid grassland

County: Cornwall			
Natural Areas:	**95 + 96**	**97**	**113**
Chamaemelum nobile	1	1	1
Crassula tillaea	1		
Erodium maritimum	1	1	1
Filago minima	1		
Hypochaeris glabra	0		
Lotus angustissimus	1	0	
Lotus subbiflorus	1	1	1
Moenchia erecta	1	1	
Ornithopus perpusillus	1	1	1
Sagina subulata	1	1	
Stellaria pallida	1	0	1
Teesdalia nudicaulis	1		
Trifolium glomeratum	1	1	1
Trifolium ornithopodioides	1	1	1
Trifolium scabrum	1	1	1
Trifolium striatum	1	1	1
Trifolium subterraneum	1	1	1
Trifolium suffocatum	1	1	1
Viola lactea	1	1	
Total no. of species extant	**18**	**13**	**11**
Total no. of species extinct	**1**	**2**	**0**
Total no. of species recorded	**19**	**15**	**11**

95 + 96 = Cornish Killas and Granite + West Penwith
97 = The Lizard
113 = Isles of Scilly

1 = Recent record
0 = Apparently extinct

Cornwall acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1986-92	Heath, Enc. relic, Field	Mostly recorded during acid fen meadow surveys	6	331.2	7.3	NI		
Heathland Inventory		1980-85	Heath, Enc. relic, Coastal cliff	Widespread on higher ground and coast	222	17345.0			1900.0	NI
Estimate, classes		1996		Jon Stewart, English Nature				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Estimate, class	A					+	A				C	C	+	+			+					

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

9. Cumbria

9.1 Physical

Geology

The Lake District is composed of lavas, tuffs, shales and slates of Silurian and Ordovician age which form the most mountainous area in England. It is surrounded by Carboniferous sediments including limestone and Triassic Sandstone. The latter underlies the coastal plain and the Eden Valley. The limestones and grits of the Pennines are extensively overlain by blanket bog.

Soils

The high ground in the county has upland soil complexes. In the Lake District, shallow rankers and brown podzols dominate but the less steeply sloping massifs to the east have humic surface-water gleys and blanket bog. In the lowlands there is a prominent area of browns sand and podzols north and east of Penrith, but there are few other areas elsewhere (**Map 1f**).

9.2 Landscape history

19th Century

The 1 inch OS maps of Cumbria were surveyed late and are difficult to read. As far as can be seen, the area of unenclosed land in the lowlands was limited.

Current landscapes and Natural Areas

The Cumbrian Fells and Dales Natural Area (NA10) is the central feature of the county, encompassing both the deeply dissected mountains and valleys of the Lake District and the limestone fringes. A large proportion of this Natural Area is upland or montane in character but lowland conditions exist in the dale bottoms and the fringes of the area. The Area passes into the low lying Natural Areas of the Eden Valley (NA9), West Cumbria Coastal Plain (NA11) and Solway Basin (NA3) which are on softer sediments, mainly sandstones, which in turn, are covered by glacial drift. These areas are fairly intensively farmed, with coastal habitats and mires the most notable semi-natural habitats.

9.3 Existing information

Flora

The coincidence maps of lowland acid grassland species listed in **Table 1** (**Maps 2** to **4**) show a rather limited lowland acid grassland flora in the Lake District. This is mostly characterised by *Teesdalia* , with localised concentrations recorded on the coast and north of Penrith. The coastal concentrations are typical of the increasing restriction of lowland acid grassland species to sand dunes and shingle in the north. The Penrith concentration includes an old record of *Herniaria glabra* and appears to be associated with heaths on brown sands. The post-1970 records suggest a serious decline. The relevant data extracted from **Table 6** is listed below.

Habitat surveys

The Grassland Inventory includes a large number of surveyed grassland sites, virtually all in the Cumbrian Fells and Dales Natural Area (NA10) where many are likely to be upland in character.

The Heathland Inventory indicates some heathland north of Penrith, including Wan Fell (NY5236), where a concentration of lowland acid grassland plant species has been recorded.

Sand dune vegetation surveys (Radley, 1994) indicate the occurrence of areas of parched acid grassland (U1) on the inland side of dune systems on stable leached acid sand, with 29.5ha recorded. *Juncus squarrosus* communities (U6) are also recorded but these are transitional to wet heath. The shingle survey (Sneddon & Randall, 1994) also suggests the presence of grasslands close to, or synonymous with, U1 in shingle sites.

Summary of consultations with Local Team Conservation Officers

The definition given for lowland heath as areas of heath below 250m is too high for defining lowland acid grassland in Cumbria. This limit, let alone the even higher limit of 350m suggested by the brief for this project, would include far too much acid grassland in the upland fringes which is clearly upland in character.

Acid grassland with a lowland character is confined to valley bottoms and to loess on the limestone in the fringes of the Lake District, the Eden Valley and the coastal fringe. A recent full Phase 1 survey of Cumbria produced a total of 110,000ha of upland and lowland unimproved acid grassland for the county. Of this, it is considered that there is about 30,000 to 50,000ha, probably nearer 30,000ha, of acid grassland below 300m, mostly Festuca-Agrostis-Galium grassland (U4), and that truly lowland acid grassland probably covers between 500-1,000ha of this area.

The lowland acid grassland is mainly U4 on enclosed land, but with some Deschampsia flexuosa grassland (U2) associated with heathland on the sandstone in the Eden Valley, and on the coast. Both U4 and U2 also occur on loess over limestone in the south. There are few special features but one exception is the occurrence of the northern orchid *Pseudorchis albida* in U4 grassland at one of its few sites in Cumbria.

One particular feature in the upland fringes are the stands of Festuca-Agrostis-Rumex grassland (U1) that occur on the shallow soils of south-facing outcrops of Silurian slates and shales, which are present in allotments and fields in the south of the Lake District. These stands can be regarded as the upper extent of lowland acid grassland, extending into the uplands in the most favourable conditions, and they have species such as *Aira praecox, Rumex acetosella, Sedum anglicum, Festuca ovina, Galium saxatile* and *Potentilla erecta.* The rare and scarce species typical of similar situations in the Welsh Marches are, however, largely absent with the possible exception of a recent record of Maiden Pink *Dianthus deltoides.* From these descriptions it would appear that the grasslands belong to the Galium-Potentilla sub-community (U1e)

Coastal grasslands in dune systems and shingle structures on the coast also contain some U1 and U4 grasslands and can be of value for lichens.

A number of rare and scarce invertebrates occur on lowland acidic grasslands within the area, in particular on the sandstones in the Eden Valley, on coastal dunes and on loess deposits on limestone around Morecambe Bay. The nationally rare High Brown Fritillary (*Argynnis adippe*) occurs in some Bracken areas in the south of the county.

9.4 Summary of resource

Extent and composition

Lowland acid grasslands are collectively quite extensive with moist acid grassland (U4) dominant but with U1, U2 and U6 grasslands also present. For the most part lowland acid grassland forms a minor part of neutral grassland, mire, rush pasture, coastal and heathland habitat mosaics and generally has a limited vascular plant interest.

Conservation value

Acid grassland has usually been regarded as a minor habitat associated with habitats of greater interest and has been included within SSSIs where associated with other habitats such as coastal habitats and heathland.

9.5 Future requirements for survey and conservation

Survey

There are no obvious priorities for Phase 2 survey of acid grassland. The Eden Valley heaths appear to have harboured a northern outpost of lowland acid grassland species at one time. The condition of this flora and its conservation needs to be investigated. The fungi flora of U4 in particular may be worth investigating.

Conservation

Conservation requirements are largely for appropriate management of lowland acid grasslands within complexes of other habitats.

9.6 References

RADLEY, G.P. 1994. *National sand dune vegetation survey of Great Britain: a national Inventory. Part 1: England.* Peterborough: Joint Nature Conservation Committee.

SNEDDON P. & RANDALL, R.E. 1994. *Coastal vegetated shingle structures of Great Britain: Appendix 3. Shingle Sites in England.* Peterborough: Joint Nature Conservation Committee.

Extract from Table 6 for Cumbria: occurrence of plant species generally faithful to lowland acid grassland

County: Cumbria	
Natural Areas:	**All**
Dianthus deltoides	0
Filago minima	1
Herniaria glabra	1
Moenchia erecta	0
Ornithopus perpusillus	1
Potentilla argentea	1
Silene conica	0
Stellaria pallida	1
Teesdalia nudicaulis	1
Trifolium striatum	1
Vicia lathyroides	1
Total no. of species extant	**8**
Total no. of species extinct	**3**
Total no. of species recorded	**11**

1 = Recent record
0 = Apparently extinct

* Note: Halliday, G. 1997, records *Dianthus deltoides* as present in the county in *A Flora of Cumbria*. Centre for North-West Regional Studies, University of Lancaster.

Cumbria acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1979-90	Field, Out-by, Mire	Virtually all in NA10, mainly upland	51	688.6	52.7	0.3		
Heathland Inventory		1982-91	Heath,Out- by, Mire	Not comprehensive	42	17714.0			100.1	
Sand Dune Survey		1980s	Coastal	U1 & U6 grassland at the back of dune systems				52.8		
Estimates ha		1996	Also rock outcrop	Ian Slater, EN				500-1000		
Estimates classes		1996		Ian Slater, EN				D		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Dune Survey	29.5																		23.4			
Estimates ha	100+					100+																+
Estimates class	C					C		C				D							A			+

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

10. Derbyshire

10.1 Physical

Geology

The Peak District in the north east and centre of Derbyshire consists of hills, dales and plateaux of Millstone Grit and Carboniferous Limestone. The lowlands to the east are on Coal Measures with some Magnesium Limestone. To the south New Red Sandstone dominates.

Soils

Areas dominated by dry acid soils in the lowlands are very limited in Derbyshire. The only areas mapped are small patches of brown sands around Derby (**Map 1e**).

10.2 Landscape history

19th Century

The 1 inch OS maps of the 1830's and 1840's show very little unenclosed land in the lowlands.

Current landscapes and Natural Areas

Derbyshire covers a diverse series of landscapes with the predominant upland Natural Areas in the north west and more lowland Natural Areas in the remainder of the county. These comprise the Coal Measures (NA24), Trent Valley and Rises (NA33), The Derbyshire Peak Fringe and Lower Derwent (NA31), the western fringe of the Southern Magnesian Limestone (NA23) and the eastern part of tbe Needwood and South Derbyshire Claylands (NA40). The lowland Areas have very little heathland or unenclosed land left and enclosed unimproved grassland is scarce. In the uplands, the White Peak (NA30) has extensive and important limestone grasslands that are transitional between the uplands and the lowlands, and which include some acidic grassland.

10.3 Existing information

Flora

The coincidence maps of the lowland acid grassland species listed in **Table 1** (**Maps 2** to **4**) suggest a rather limited lowland acid grassland resource in Derbyshire. At least 9 species have been recorded but there are no obvious concentrations. This is confirmed by the Flora of Derbyshire (Clapham, 1969). The relevant data extracted from **Table 6** is given below.

Habitat surveys

The Grassland Inventory shows many limestone grassland sites in the White Peak, and within these fringing acid grasslands were often recorded. Habitat studies in the Flora of Derbyshire suggest NVC community U4c on the edge of limestone (SK177744) in the White Peak, and U2 in the southern lowlands, at Carver's Rocks (SK332228). All the samples of U4c in the NVC, Volume 3, are in the Derbyshire Dales.

The Heathland Inventory records only small fragments of heathland, mainly to the east. This is confirmed by the Biological Survey of Common Land (Crowther & Aitchison, 1993a) which records a single lowland, ungrazed, common with acid grassland (Wessington, SK371577). This has *Nardus* and *Deschampsia flexuosa* dominated grassland (U2 & U5).

Summary of consultations with Local Team Conservation Officers

Although acid grassland is widespread in the uplands it is generally rare in enclosed and lowland situations. It was frequently recorded during limestone grassland surveys in the dales of the White Peak (NA30), which is regarded as lowland in character by the Local Team, but it only forms a small part of the grassland resource in this area.

Typically acid grassland occurs as small patches and strips at the top of the dale sides where the drift obscures the limestone. Most dales have fragments, but a large area of grassland has been recorded in the Wardlow Hay Cop area of Cressbrook Dale (SK1773). All this acid grassland is Festuca-Agrostis-Galium grassland (U4) with unimproved examples conforming to the Vaccinium sub-community (U4e) or the *Lathyrus montanus - Stachys betonica* sub-community (U4c). However, semi-improved examples of acid grassland are frequent. These are likely to belong to the Holcus-Trifolium sub-community (U4b). The U4e can grade into dry heath (Calluna-Ulex gallii heath, H8). The Lathyrus-Stachys sub-community (U4c) is recognised as a typically very narrow transition between calcicolous grassland and acid grassland. Longstone Moor SSSI in the White Peak has limestone heath and quite a large area of U5. It may represent the type of grassland which was formerly more widespread in the White Peak plateau.

In the White Peak, small lenses of refractory silica sand have been quarried in the past, leaving hummock terrain with pools and acid sand. These abandoned quarries support Great Crested Newt colonies in the pools and open, bryophyte-dominated, communities with *Polytrichum* species prominent on sand slopes. These cannot be described as typical parched acid grassland (Festuca-Agrostis-Rumex grassland, U1) although they contain many species from this community. They are largely ungrazed and tend to develop into rank grassland (Arrhenatherum grassland, MG1) or Hawthorn scrub.

The open communities are botanically notable for the occurrence of Clubmosses (Stagshorn Clubmoss *Lycopodium clavatum*, Fir Clubmoss *Huperzia selago* and Alpine Clubmoss *Diphasiastrum alpinum*). The best site, Bees Nest & Green Clay Pits SSSI, has all three Clubmosses and sheep grazing has recently been started to maintain open conditions.

Beyond the White Peak lowland acid grassland is very restricted in extent. On the Gritstone only one SSSI, Colshaw Pasture, has been notified for enclosed acid grassland but at 400m, this is decidedly upland with *Alchemilla* species and has some similarity to Anthoxanthum-Geranium sylvaticum grassland (MG3). Acid grassland is extensive in this area but only as a part of upland moorland complexes.

In the Coal Measures (NA24), Moss Valley Meadows SSSI has some acidic grassland but this is transitional between U4 and Cynosurus-Centaurea grassland Danthonia sub-community (MG5c). Coal waste in this area normally carries only transient acid grassland as Birch rapidly colonisies to produce woodland.

In the Derwent Valley there are a few fragments in fields or associated with relic heath. These include Deschampsia flexuosa grassland (U2), Festuca-Agrostis-Galium grassland (U4) and Nardus grassland (U5), including about 1ha of U4 and U5 in the Mercaston Marsh & Muggington Bottoms SSSI (SK272430). This area is notified for wet acid grassland communities (Juncus-Galium rush pasture, M23 and related communities).

10.4 Summary of resource

Extent and composition

Beyond the acid grasslands associated with the dales, the area of acid grassland is very limited, and probably extends only to a few tens of hectares. Even when added to the area in the dales it is likely that there is less than 50ha of acid grassland in lowland Derbyshire. The communities present are probably U4b, U4c and U4e in the dales and U2, U4 and U5 elsewhere.

Conservation value

The acid grassland at the tops of the dales in the White Peak is an integral part of the very important limestone grassland complexes found here, rated as of outstanding importance by Jefferson (1996). As such it is of interest as part of the habitat mosaic here, and the transition between calcicolous and acid grasslands is a valuable part of this mosaic. In other parts of Derbyshire acid grassland is probably best regarded as being of particular value where it is associated with other features of interest, such as neutral grassland, mires and heath.

10.5 Future requirements for survey and conservation

Survey

The area of lowland acid grassland is so limited that there is little point in any specific survey of this habitat. However it is considered that there is a local need for further Phase 2 survey of neutral grassland, and this could include a survey of any acid grassland found.

Conservation

No national priorities apart from maintaining the mosaic of grassland types in the White Peak.

10.6 References

CLAPHAM, A.R. 1969. *Flora of Derbyshire.* Derby: County Borough of Derby Museum & Art Gallery.

CROWTHER, K. A. & AITCHISON, J.W. 1993a. *Biological survey of common land. No 26: Derbyshire.* Peterborough: English Nature

JEFFERSON, R.G. 1996. Lowland grassland in Natural Areas: national assessment of significance. Peterborough: *English Nature Research Reports*, No. 171.

Extract from Table 6 for Derbyshire: occurrence of plant species generally faithful to lowland acid grassland

County: Derbyshire	
Natural Areas:	**All**
Chamaemelum nobile	0
Dianthus deltoides	1
Filago minima	1
Moenchia erecta	0
Ornithopus perpusillus	1
Potentilla argentea	1
Stellaria pallida	1
Teesdalia nudicaulis	1
Trifolium striatum	1
Total no. of species extant	**7**
Total no. of species extinct	**2**
Total no. of species recorded	**9**

1 = Recent record
0 = Apparently extinct

Derbyshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1987-91	Calc/drift, Field, Park, Waste	Most as part of Dales limestone grassland survey	68	2196.6	806.0	5.5		
Heathland Inventory		1983-95	Field, Waste, Enclosure relic	Small fragments, mainly in east	12	73.0			11.8	
Common Land Survey	SK371 577	1993	Common	One ungrazed lowland common, CL47	1	7.2	6.6	2.8		
Estimates, classes		1996		Ian Taylor, EN				A		

Survey Name	U1	U1a	U1c	U1b	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Common Land								+										+				
Estimates								A				A		A	A		A	A				

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

11. Devon

11.1 Physical

Geology

Beyond the granite intrusion which forms the uplands of Dartmoor, Devon is dominated by sedimentary rocks, mainly sandstones and shales of Devonian and Carboniferous age. In the east New Red Sandstone dominates the lower grounds with a capping of Upper Greensand forming the Blackdowns. On the south coast there is an outcrop of Precambrian metamorphic rock at Start Point and Bolt Head.

Soils

Beyond the upland soils of Dartmoor and Exmoor there are large areas of podzols and brown sands in the Devon Redlands Natural Area (NA90). In other areas brown podzolic soils dominate valley sides (**Map 1a**).

11.2 Landscape history

19th Century

In the early 19th century small commons were widespread except in South Devon. In the Devon Redlands Natural Area very large areas of common land occupied ridge tops at Great and Little Haldon, and the heaths of the Devon Pebble Beds, while smaller commons also dominated the ridge tops on the Blackdowns. Most of these have since been enclosed.

Current landscapes and Natural Areas

Dartmoor (NA92) and Exmoor and the Quantocks (NA87) Natural Areas contain extensive unenclosed upland heathland and moorland. Between the two moors, The Culm Natural Area (NA93) is noted for is rich wet acid grassland whilst the Devon Redlands Natural Area (NA90) still contains large areas of heathland on the East Devon Pebblebeds. In the South Devon Natural Area (NA91) coastal cliff habitats are the main interest. Finally the Blackdowns Natural Area (NA89) contains a few areas of heathlands as well as many wetter grasslands on seepage lines.

11.3 Existing information

Flora

The coincidence maps of the lowland acid grassland species listed in **Table 1** (**Maps 2** to **4**) show a very rich acid grassland flora along the coasts and on the fringes of Dartmoor. The coastal flora includes many southern oceanic species including *Erodium maritimum*, *Lotus angustissimus*, *Lotus subbiflorus*, *Trifolium glomeratum*, *Trifolium ornithopodoides* and *Trifolium scabrum*. The Dartmoor fringes support species such as *Chamaemelum nobile*, *Filago minima*, *Ornithopus perpusillus* and *Teesdalia nudicaulis* and once contained *Hypochaeris glabra* (now extinct). The Devon Redlands Natural Area is also quite rich but the Blackdowns and The Culm are remarkably poor in dry acid grassland species. The north coast records appear to be mainly associated with dune systems. The post-1970 records indicate considerable losses. One rare species which may be associated with parched acid grasslands on rock outcrops is *Hypericum linariifolium*.

Lists of lowland acid grassland species for some of the Natural Areas were determined from Ivimey-Cook (1984) and are given in **Table 6**. The relevant data has been extracted from this table and is reproduced below.

Habitat surveys

The Grassland Inventory indicates that little dry acid grassland has been surveyed. The Heathland Inventory records surviving heathland as occurring mainly in the fringes of Dartmoor and the Devon Redlands. Beyond this, the only published reference to acid grassland is the recording of 0.67ha in the very rich dune site of Dawlish Warren on the south coast (Radley, 1994).

The maps in the NVC Volume 3 indicate that U1e, U1f, U4a, U4b and U4e were sampled from the county (Rodwell, 1992).

Summary of consultations with Local Team Conservation Officers

The problem of distinguishing between upland and lowland grassland in Devon is particularly difficult, with acid grassland often regarded as degraded heathland in the uplands. In Devon the boundaries of economic Less Favoured Areas such as Exmoor and Dartmoor are considered the best way of splitting off upland from lowland.

The acid grassland of Dartmoor, although upland or upland fringe, is of interest. Here there is 5,300ha of acid grassland and 4,900ha of Bracken supporting the densest population of Wheatears in southern England, numbering around 1,500 pairs. The area is also important for the plants *Viola lactea* and *Chamaemelum nobile* and the High Brown (*Argynnis adippe*) and Pearl Bordered Fritillary (*Boloria euphrosyne*) butterflies.

Beyond Dartmoor there is approximately 100-500ha of acid grassland. This largely comprises moist acid grassland (Festuca-Agrostis-Galium grassland, U4), with small amounts of Deschampsia flexuosa grassland (U2), parched acid grassland (Festuca-Agrostis-Rumex grassland, U1) and a little Agrostis curtisii grassland (U3). Generally acid grassland occurs in mosaics with more interesting habitats, or is the result of degradation of heath. The Blackdowns has the most dry acid grassland, followed by The Culm, with only small amounts elsewhere.

A current survey of the Red Data Book plant *Lotus angustissimus* has identified a species-rich type of the little known NVC community Festuca-Agrostis-Rumex Grassland Hypochaeris sub-community (U1f), which occurs in small areas of thin droughty soil on coastal cliff tops (Simon Leach pers. com. 1996). Associated with the *Lotus angustissimus* are species such as *Lotus subbiflorus*, *Trifolium glomeratum*, *Trifolium ornithopodioides*, *Trifolium scabrum*, *Moenchia erecta*, *Erodium maritimum* and *Erodium moschatum*. Quadrat data has shown there to be little *Festuca rubra* and no *Festuca ovina*, although considerable *Vulpia bromoides*. A constency table for U1f, based on quadrat data from the survey, is presented in Volume I, Appendix 1, to illustrate the richness of this cliff top acid grassland. The community is best developed from Start Point in Devon to Looe in Cornwall, on the south coast. It is less well-developed on the north coast where south-facing slopes are rare. The coastal habitat where this community occurs is much degraded by the lack of grazing and spread of Gorse, and many stands are therefore reduced to narrow bands along paths.

11.4 Summary of resource

Extent and composition

The status of lowland acid grassland in Devon is complicated and the areas with the most dry acid grassland in a definitely lowland situation, the Blackdowns and The Culm Measures, are of low floristic interest. In contrast, small areas of acid grassland present on the south coast and the Devon Redlands have, or have had, the richest acid grassland flora. The decidedly upland Dartmoor has very strong lowland elements in its grasslands at lower altitudes, with quite a rich lowland acid grassland flora recorded.

Conservation value

In Devon the richness of the flora rather than the extent of lowland acid grassland is of more significance for nature conservation. The importance of the southern oceanic element found in the warmest acid grasslands in southern Devon has been overlooked until the work of Simon Leach. Together with Cornwall, the coastal cliff tops in Devon are one of the most important areas for acid grassland in the country. The transitional nature of the Dartmoor fringe grasslands is likely to confer added value when compared to other upland acid grasslands.

11.5 Future requirements for survey and conservation

Survey

It is not considered that there is a need for Phase 2 survey of acid grasslands in Devon although the over- looked floristic richness of some acid grasslands will require further investigation. The cliff top U1f vegetation is a priority due to the threat from habitat neglect but some inland areas are also indicated as having been of great interest and should be followed up.

Conservation

The restoration of grazing and gorse management to the cliff top grasslands is a high priority. Heathland restoration, especially including grazing, is probably also important in the lowland heaths of southern Devon.

11.6 References

IVIMEY-COOK, R. B. 1984. *Atlas of the Devon flora.* Exeter: The Devonshire Association for the Advancement of Science, Literature and Art.

RADLEY, G. P. 1994. *National sand dune vegetation survey of Great Britain: a national Inventory. Part 1: England.* Peterborough: Joint Nature Conservation Committee.

Extract from Table 6 Devon: occurrence of plant species generally faithful to lowland acid grassland

County: Devon					
Natural Areas:	**89**	**90**	**91**	**92**	**87/93**
Chamaemelum nobile	0	0	1	1	1
Crassula tillaea			1		
Erodium maritimum			1		1
Filago minima		1	1	1	1
Hypochaeris glabra		0	0		0
Lotus angustissimus		0	1		1
Lotus subbiflorus	0	1	1		1
Moenchia erecta	1	1	1	0	1
Ornithopus perpusillus	1	1	1	1	1
Potentilla argentea		0	0	1	
Sagina subulata	1	1	1	1	1
Stellaria pallida			1		
Teesdalia nudicaulis	0	1	1	1	1
Trifolium glomeratum		1	1		1
Trifolium ornithopodioides		1	1		1
Trifolium scabrum		1	1		1
Trifolium striatum		1	1		1
Trifolium subterraneum	1	1	1		1
Viola lactea	0	1	1	1	1
Total no. of species extant	**4**	**12**	**17**	**7**	**15**
Total no. of species extinct	**4**	**4**	**2**	**1**	**1**
Total no. of species recorded	**8**	**16**	**19**	**8**	**16**

89 = Blackdowns
90 = Devon Redlands
91 = South Devon
92 = Dartmoor
87/93= North Devon, Exmoor and the Quantocks and The Culm

1 = Recent record
0 = Apparently extinct

Devon acid grassland surveys

Survey	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1984-91	Field, Enc. relic, Heath	Very limited survey	9	247.2	37.7	NI		
Heathland Inventory		1974-94	Heath and Enclosure relics	Mainly NA90 & Dartmoor fringe + Coastal cliffs	150	1129.0			1960.0	51.1
Estimates, Classes		1996		Rob Wolton, English Nature				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Estimates, Class	A					A	A	A			A	C	+	+			+					+

Key

Column headings

GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates

A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

12. Dorset

12.1 Physical

Geology

The youngest deposits in Dorset are the Tertiary sands and clays of the Poole Basin. These are surrounded by the Chalk downs with local caps of acid drift. Beyond the Chalk, a complex mixture of Lower Cretaceous and Jurassic sediments exist, including the acid sands of the Upper Greensand and the Bridport Sand. There are recent sand terraces by the River Avon.

Soils

Extensive areas of soils associations dominated by podzols are confined to the Tertiary deposits of the Poole Basin and on relic Tertiary sediments that cap the Downs. Recent deposits giving rise to acidic soils include sand terraces by the River Avon, including areas of inland blown sand at Cowards Marsh (SZ1595) (**Map 1a**).

12.2 Landscape history

19th Century

The Poole Basin was dominated by vast, unenclosed, heathland commons in the early 19th century. Elsewhere, unenclosed rough grazings were widespread, including quite extensive areas on the chalk downs and smaller hilltop heathlands to the west.

Current landscapes and Natural Areas

The Poole Basin (Dorset Heaths Natural Area (NA81)) still contains large areas of heathland in spite of the well-documented and massive losses in the last two hundred years. Some of the Poole Basin acid grasslands may be a consequence of past heathland reclamation that did not proceed towards intensive agriculture. To the north of the heaths, the South Wessex Downs (NA80) have suffered an even more drastic loss of rough grazing, with virtually all the plateau grassland ploughed up, although scarp downland is still widespread and relics of more acidic grassland can be found at the top of scarp slopes on superficial acidic deposits and locally on flint screes on the slopes. Many of the top-of-slope localities have suffered eutrophication from adjacent intensive agriculture.

The Purbeck area (Isles of Portland and Purbeck (NA82)) to the south has a remarkable mix of landscapes in a small area and includes the outstanding Corfe Common, which is on acid soils. To the west, the Wessex Vales (NA83) and a small area of the Blackdowns (NA89) still harbour relics of hill top heathlands.

12.3 Existing information

Flora

The coincidence maps of the lowland acid grassland species listed in **Table 1** (**Maps 2** to **4**) show an exceptional concentration of acid grassland species in the Poole Basin and Purbeck. This flora, although showing a decline, is still significant. Beyond these areas, the acid grassland flora is very limited.

The acid grassland floras of the east and west of the county are compared in **Table 6**, from which the relevant data is extracted and given below. The comparison is striking; in the east of the county twenty four characteristic species have been recorded, of which one is probably extinct, whilst in the west, only five species have been recorded, of which two are probably extinct. The total recorded from the east of the county is one of the highest recorded in England. The condition of the acid grassland flora, however, is critical. Many are listed in the county red data book (Mahon & Pearman, 1993) and have suffered a serious decline in this century.

Byfield & Pearman (1996) have produced very valuable data on this decline in a study which re-surveyed 390 heathland stands from which the vascular plant flora had originally been recorded in the 1930s by Professor R. Good. They found that 35% of these stands had been destroyed, 22% by agriculture and 7% by forestry. Three-quarters of the surviving stands have received some form of protection as nature reserves and/or SSSIs. The declines in the occurrence of 41 species of particular note however, were much greater. In total there had been a 75% loss of such species from the stands, including 11 species listed in **Table 1**. For these species the decline was even higher, at 88%. In contrast, wet heath species and valley mire species had declined by 41% and 50% respectively. It was concluded that the primary cause of the much higher decline in dry acid grassland species than heath and mire species was the cessation of grazing on the Dorset Heaths.

The modern distribution of nine of the species in **Table 1** have been mapped by Dorset Environmental Record Centre (DERC) by 1km grid square. These are reproduced below to give an indication of the fine detail of the likely distribution of acid grassland (**Map 25** to **33**).

Fauna

The contractor is not aware of any general description of the contribution of acid grassland to the important invertebrate and vertebrate fauna of the Dorset Heaths. As examples, however, there are several studies of the fauna of an area of acid grassland developed in abandoned sand and clay workings in former heathland around Sandford, Wareham (SZ98) (Corbett *et al*, 1994, Edwards, 1994, Jones 1995, Parker, 1994, Roberts, 1994, Roberts, 1996).

The most interesting vertebrate records have come from an area of Gorse and *Agrostis curtisii* (U3) which has been burned some years before. Here a colony of Sand Lizards has been recorded and a Nightjar nest noted. Both these species appear to be able to use the grassland because of the cover offered by the regrowing Gorse.

The invertebrate fauna includes the declining Notable species of Asilid fly, *Asilus crabroniformis*, which is now believed to be extinct in many areas, eg East Anglia, and it may be revised to RDB3 soon. The Aculeate Hymenoptera records include the RDB2 Bee Wolf *Philanthus triangulum*, one of the first records for Dorset since 1829, (subsequently spreading in the south), along with other rare and scarce species including the RDB3 *Nomada goodeniana*. The Orthoptera includes the nationally notable Tawny Cockroach *Ectobius pallidus* and the county notable Stripe-winged Grasshopper *Stenobothrus lineatus* and Mottled Grasshopper *Myrmeleotettix maculatus*. The spider fauna is not particularly rich but includes the ant mimic *Micaria romana*, normally found on calcareous grassland in southern England.

Habitat surveys

The Grassland Inventory reflects the Phase 2 survey of Porley (1992) discussed below. The Heathland Inventory shows the concentration of heathland in the Poole Basin with a scatter of hill top sites to the west.

Calcifugous grasslands in Dorset (Porley, 1992).

Porley's Phase 2 survey of acid grassland in Dorset was carried out in late summer and did not cover the bulk of the Poole Basin. However, it gives a good idea of the range of acid grasslands in parts of the county.

In the Poole Basin and Purbeck, parched acid grassland (U1) dominates with the typical sub-community (U1b) found on the very sandy terraces along the west bank of the River Avon and the Hypochaeris sub-community (U1f) elsewhere, with a few stands of U1d and U1e. Corfe Common also had Argrostis curtisii grassland (U3), which is also widespread in the many unsurveyed stands in the Poole Basin. Porley also described extensive herb-rich Bracken stands found at Corfe Common as Festuca-Agrostis-Galium grassland Lathyrus-Stachys sub-community (U4c). Personal experience (N. A. Sanderson), however, suggests that these stands are similar to the herb-rich Bracken stands (a variant of U20) of the New Forest, and have less relation to U4c as described in the NVC.

The western acid grasslands also have parched acid grasslands (U1b & U1f) and Agrostis curtisii grassland (U3) but the main difference is the appearance of moist acid grasslands (U4). Selected data from a western site are presented in Volume I, Appendix 1, as an example of U4 in enclosed pasture.

Sandford acid grassland (Colebourn, 1994 & Sanderson, 1995c)

A Phase 2 survey was carried out of the acid grasslands at Sandford. The dry grasslands included 1.7 ha of U1f, locally approaching the Anthoxanthum-Lotus sub-community (U1d), and on the less disturbed areas, 0.6ha of Agrostis curtisii grassland (U3).

The total flora of the site, which includes *Junco-Molinion* grasslands and an ephemeral pond as well as the dry acid grasslands, totalled 197 species. There were 10 acid grassland species listed in **Table 1** found by Ecological Planning & Research (EPR) in 1995, and since the original EPR survey J. Cox of English Nature has added *Hypochaeris glabra* and *Lotus subbiflorus*, and a further unpublished EPR survey has added *Potentilla argentea* and *Moenchia erecta*. The total of fourteen species is higher than the total found in many other counties, and in the whole of west Dorset! A total of 32 species on the provisional indicator list (**Table 8**) were recorded, including six nationally scarce species. These figures give an indication of the level of plant species richness to be expected from a very high quality lowland acid grassland site.

Summary of consultations with Local Team Conservation Officers & local experts

DERC has recently tabulated Phase 1 data from SSSI and SNCI notifications, giving the totals for unimproved and semi-improved acid grassland from Dorset as 462ha and 421ha respectively.

In the east of the county U1 and U3 acid grasslands dominate. Of the parched acid grassland, U1b is confined to free draining substrates, mainly the very sandy area west of the Avon, and is often characterised by the presence of *Carex arenaria*. On the more impeded soils which are more typical of the east of Dorset, U1f is more typical. This sub-community can also occur as small stands on banks and anthills in neutral grasslands.

Small patches or fragments of U1a, U1c, U1d and U1e have also been recorded. Where these and the U3 grassland are grazed, they can be rich in species declining generally in the countryside. Ungrazed stands, especially the Agrostis curtisii grasslands (U3), are usually very species-poor. The best areas tend to be found in grazed relic heathland, old mineral workings or grassy grazed commons and not in the famous blocks of heathland which often have rather over-grown grasslands. Many of these are derived from failed attempts at heathland reclamation. The restoration of grazing to some of the larger blocks has begun and this should increase the area of high quality acid grassland. Most smaller acid grassland fragments are now covered by SSSIs or SNCIs but in the recent past the natural rush to protect the surviving heaths led to a few high quality grassland sites being over-looked. The SNCI series has probably picked up most of these and in at least one case a SSSI has been extended to cover a high quality site.

Sand Lizards often utilise the edges of acid grassland as basking areas where it is mixed with taller dry heath, and the rare bush cricket, the Wart-Biter (*Decticus verrucivorus*) survives in an area of acid grassland mixed with dry heath. The fauna of acid grassland, where this is associated with heathland, can be particularly rich, some species use both habitats.

In the west of the county, acid grassland is mainly found on clay with flint caps, and on the Bridport Sand. As well as mixtures of U1f, U1e and U3 with heath (H4) in heathland relics there are extensive areas of species-poor, often semi-improved, Festuca-Agrostis-Galium grassland (U4). The U4 stands at Pilsden Pen suggest that at least some of these grasslands are the result of the conversion of heathland mosaics of H4, U3 and U1 on enclosure by ploughing and fertilising. Reversion as can be seen at Lambert's Castle where U4 grades to U1e. It is reported that there are several areas of acid grassland on the Greensand and clay with flints over Chalk in the centre of Dorset, which had not been surveyed (J.Cox pers. comm. 1996), including Woodland Hill, Bulbarrow; Okeford Hill, Okeford Fitspaine and Giant Hill, Cerne Abbas.

12.4 Summary of resource

Extent and composition

There is 500-1000ha of acid grassland in Dorset, evenly distributed between the south east and the rest of the county. The acid grasslands of the south east are much more varied and species-rich than those of the west, which include large areas of species-poor semi-improved grassland.

Conservation value

The acid grassland of the Poole Basin and Purbeck, although greatly reduced in area, is of great importance at a national level, and is an integral part of the conservation value of the internationally important heathlands of Dorset. Outside the Poole Basin the most important single site is Corfe Common which is comparable with the best of the New Forest dry grasslands and is easily of national or international importance in its own right. The acid grassland flora is among the most threatened features of the Dorset Heaths. While some acid grassland has been covered by SSSI extension, the conservation of fragmented and small sites still present a considerable challenge.

In comparison, the acid grasslands of west Dorset are of limited significance in a national context. The main significance of the U4 grasslands is probably their role in indicating areas where heathland restoration could be worth while.

12.5 Future requirements for survey and conservation

Survey

The Local English Nature team suggested that acid grasslands on the clay with flints over the Chalk could be surveyed at Phase 2 level but EPR considers these to be a relatively low national priority; they are species poor and potentially semi-improved.

Fragments of rich acid grassland in the Poole basin have been surveyed to the Phase 1 level with species lists (Brian Edwards, pers. com. 1996). EPR considers that given the threats to, and the importance of, the south eastern Dorset acid grasslands, this is not adequate. At a minimum the existing data requires collation, with possibly some follow-up Phase 2 survey.

Conservation

The conservation of the acid grasslands of the Poole Basin is one of the highest priorities in the recovery of the Dorset Heaths. The decline of acid grassland species described by Byfield & Pearman (1996) has occurred even faster on protected sites than on unprotected sites, and is due to the lack of effective management. The re-introduction of extensive grazing to surviving heathlands is likely to be the most useful method and return of stock is already under way.

The next priority should be the re-creastion of acid grassland from intensive agriculture and is likely to be easier than the re-creation of species-poor dry heath. Acid grassland and heathland re-creation should have equal priority although the area of grassland perhaps could be a fraction of the area of heath, say a minimum of 10%.

12.6 References

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Extract from Table 6 for Dorset: occurrence of plant species generally faithful to lowland acid grassland

County: Dorset		
Natural Areas:	**81/82**	**80/83**
Grasses		
Vulpia ciliata ambigua	1	
Other Vascular Plants		
Chamaemelum nobile	1	0
Crassula tillaea *	1	
Dianthus deltoides	1	
Erodium maritimum	1	
*Filago minima**	1	
Gladiolus illyricus	0	
*Hypochaeris glabra**	1	
Lotus angustissimus	1	
*Lotus subbiflorus**	1	
*Moenchia erecta**	1	1
*Ornithopus perpusillus**	1	1
*Potentilla argentea**	1	
*Sagina subulata**	1	
*Stellaria pallida**	1	
Teesdalia nudicaulis	1	
Trifolium glomeratum *	1	0
*Trifolium ornithopodioides**	1	1
Trifolium scabrum	1	
*Trifolium striatum**	1	
*Trifolium subterraneum**	1	
Trifolium suffocatum	1	
Vicia lathyroides	0	
*Viola lactea**	1	
Total no. of species extant	**22**	**3**
Total no. of species extinct	**2**	**2**
Total no. of species recorded	**24**	**5**

Species recorded from Sandford = *

81/82 = Dorset Heaths and Isles of Portland and Purbeck
80/83 = South Wessex Downs and Wessex Vales

1 = Recent record
0 = Apparently extinct

Dorset acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1984-90	Enclosure relics & Grass heath	Heathland areas poorly covered	20	2177.7	13.0	NI		
Heathland Inventory		1982-94	Heathland and Enclosure relic	Most in Dorset Heaths + Wessex Downs & Vales	170	15428.0			2125.8	0.0
Porley (1992) NA 81/82		1992	Enclosure relics & Grass heath	Report on Phase 2 survey	7	NI	NI	NI		
Porley (1992) NA 80/83		1992	Enclosure relics as hill top caps	Report on Phase 2 survey	6	NI	NI	NI		
Sandford (EPR, 1994-95)		1994-95	Mineral workings	Site with 14 acid grassland spp			2.3			
SSSI & SNCI Phase 1		1996		Figures from DERC Unimproved/semi-improved				462/421		
Estimates NA 81/82		1996	Enclosure relics, Heath, Grassheath	Brian Edwards, DERC				C		
Estimates NA 80/83		1996	Enclosure relics on hill tops	Brian Edwards, DERC				C		
Estimates, county		1996		Brian Edwards, DERC				D		

Survey Name	U1	U1a	U1d	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Porley NA81/82	+		+		+	+	+				+											+
Porley NA80/83	+						+	+	+		+	+	+	+	?							
Sandford(94-95)					+		1.7				0.6											
SSSI & SNCI																						
Est. NA 81/82	B	?	A	?	A	A	B				B											A
Est. NA 80/83	A		A			A	A	A	A		A	C	A	B	?							
Est. county	B	?	A	?	A	A	A	A	A		B	C	A	B	?							A

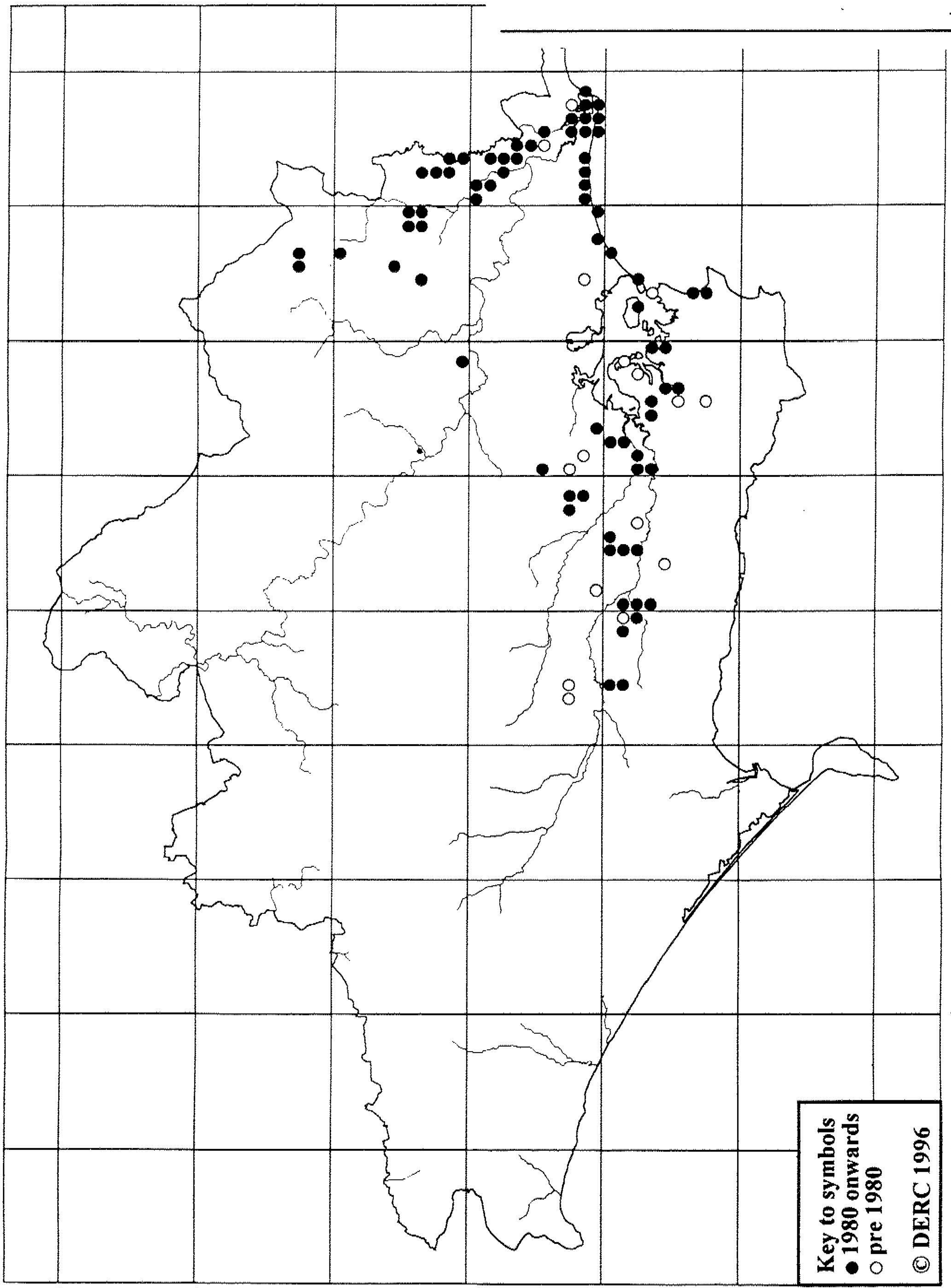
Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

Distribution of Crassula tillaea in Dorset

Map 25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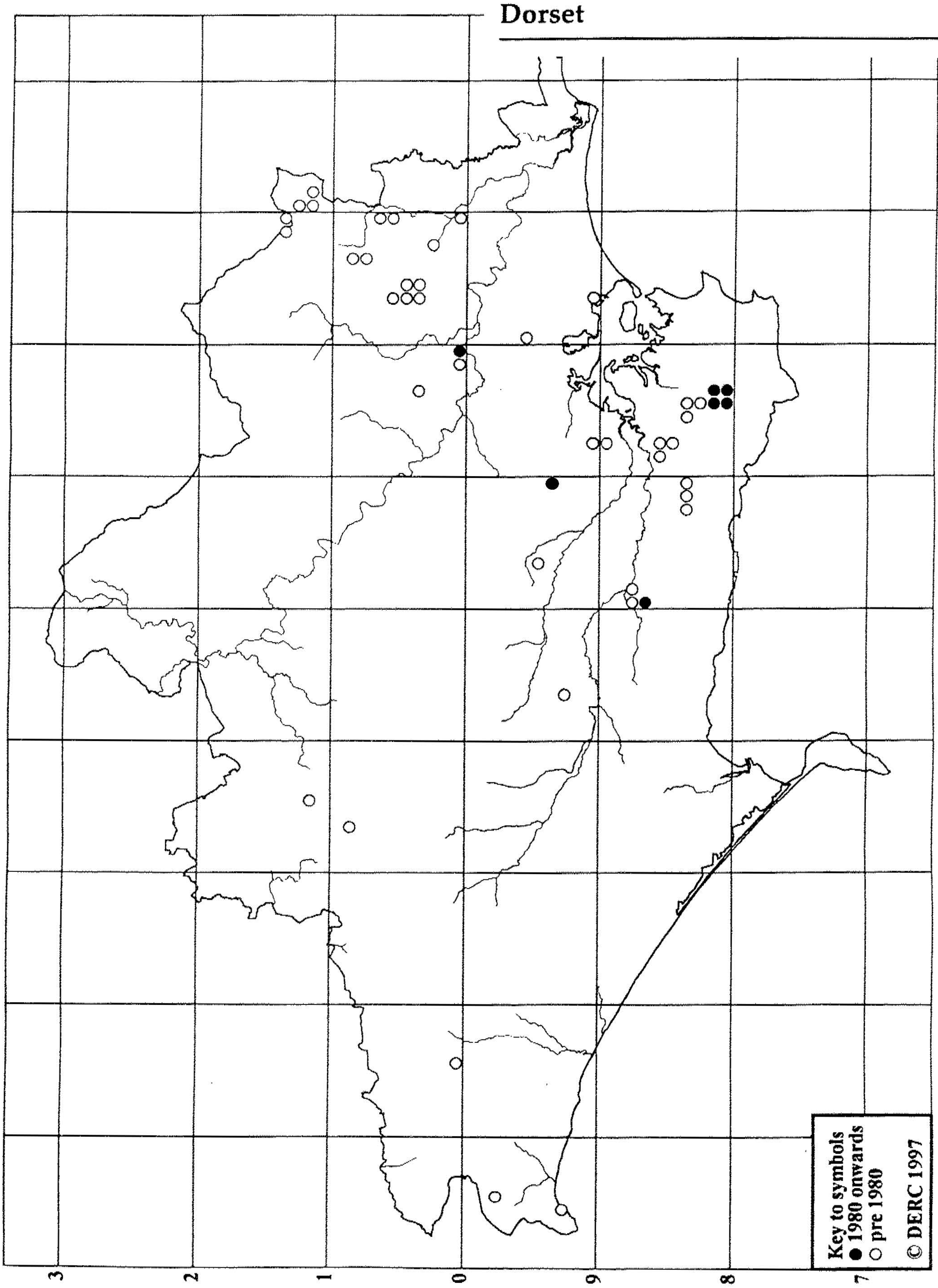
Distribution of Chamaemelum nobile in Dorset

Map 2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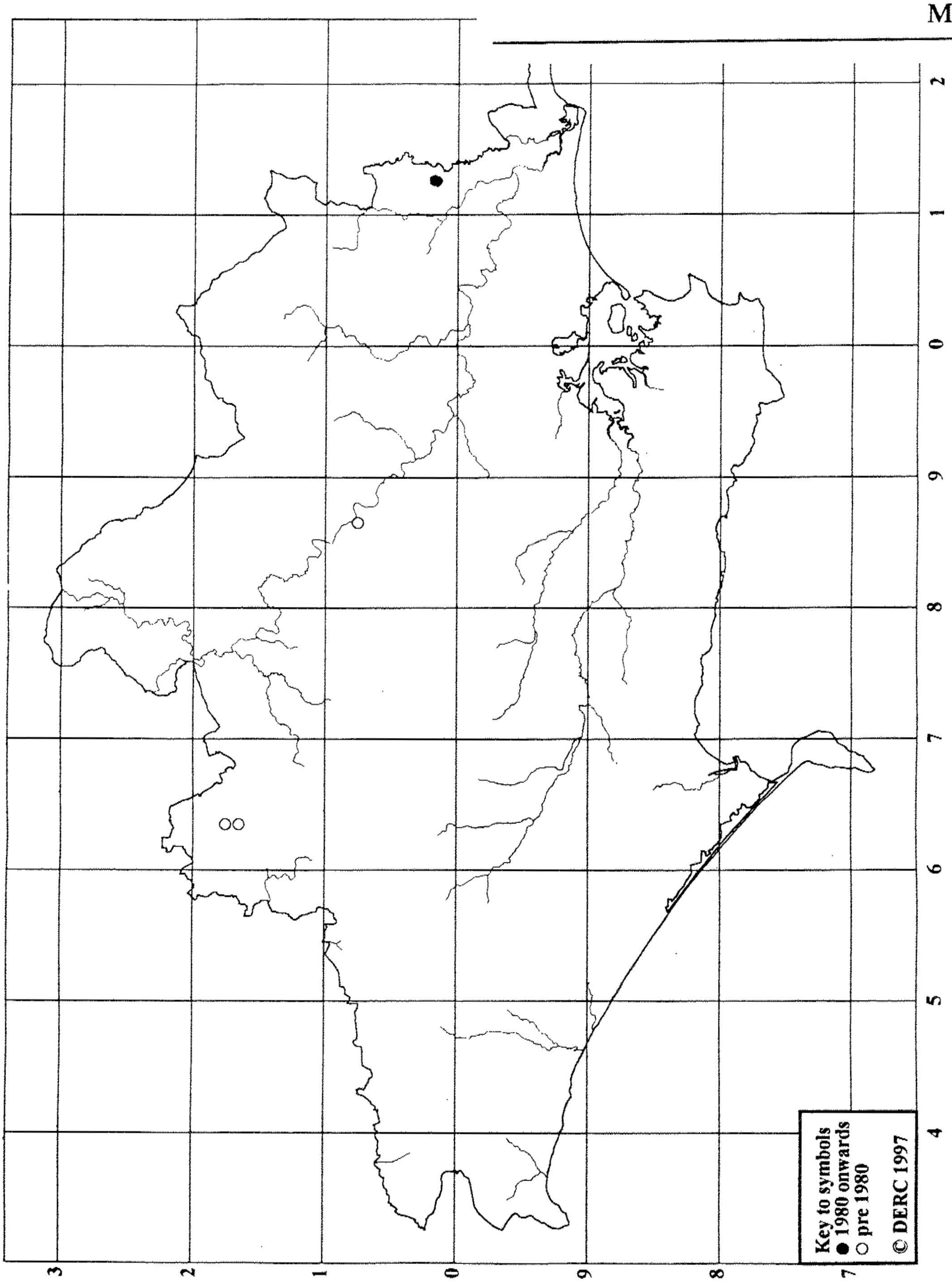
Distribution of Dianthus deltoides in Dorset

Map 27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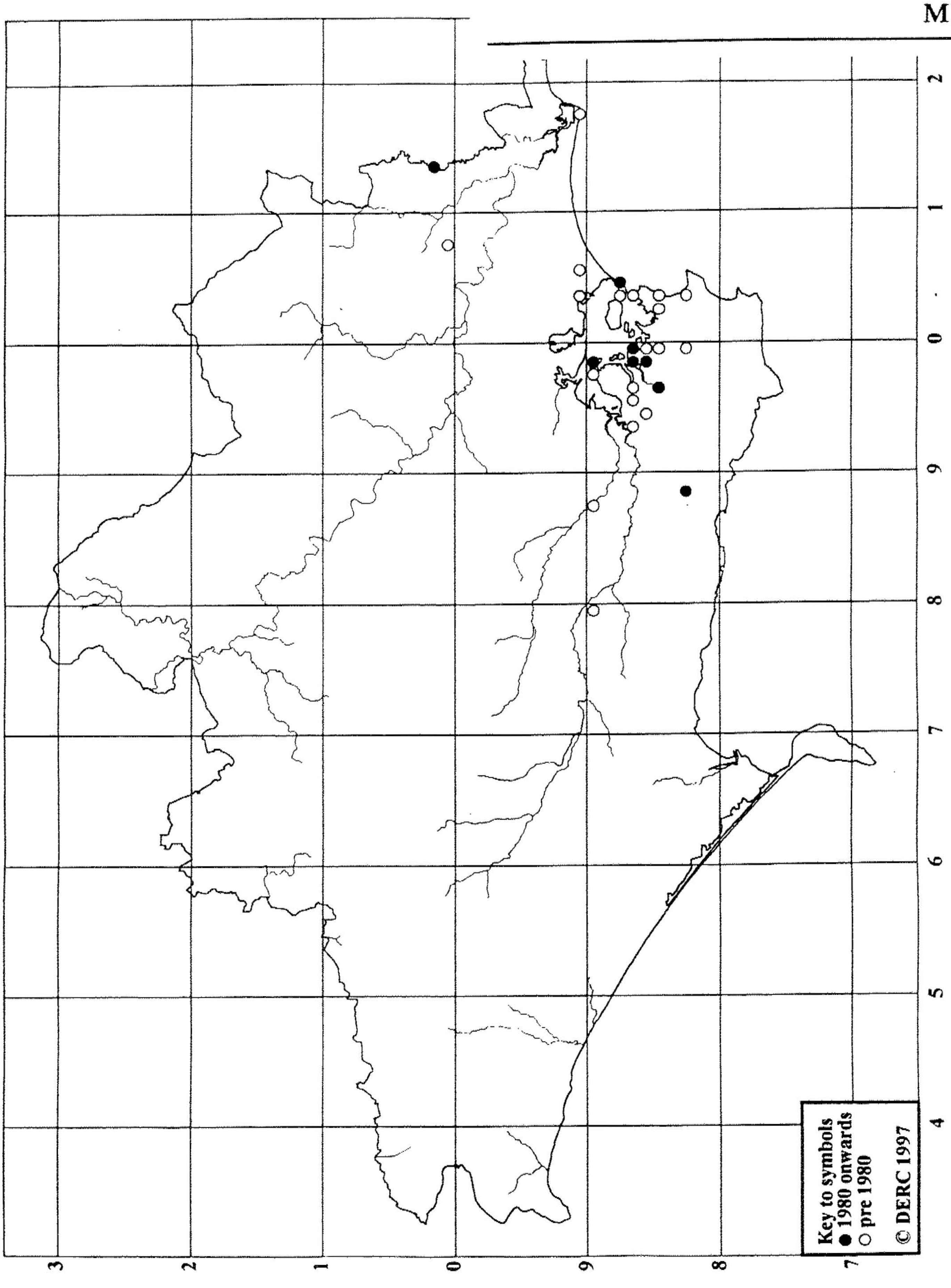
Distribution of Hypochaeris glabra in Dors

Map 2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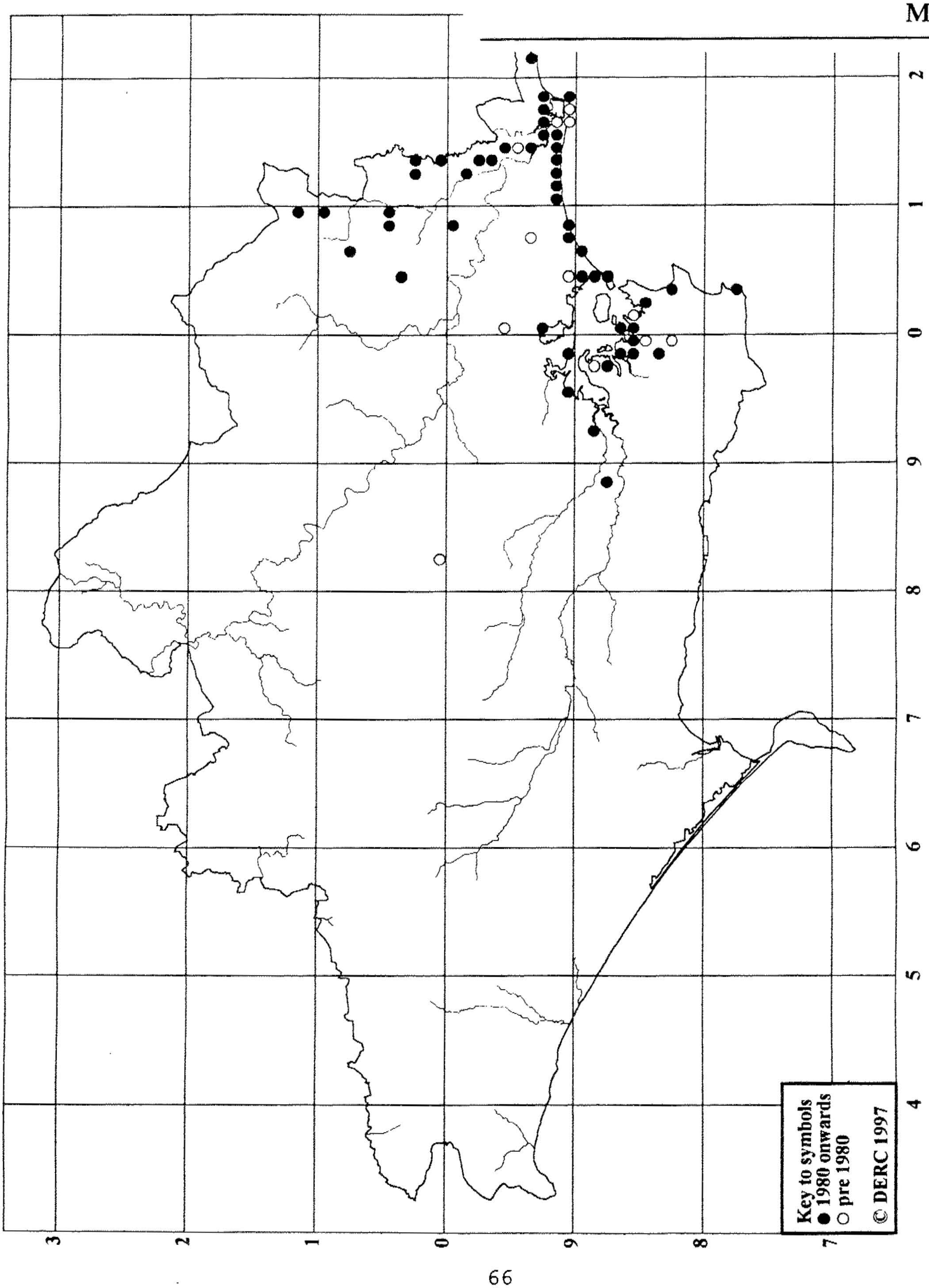
Distribution of Lotus subbiflorus in Dorset

Map 29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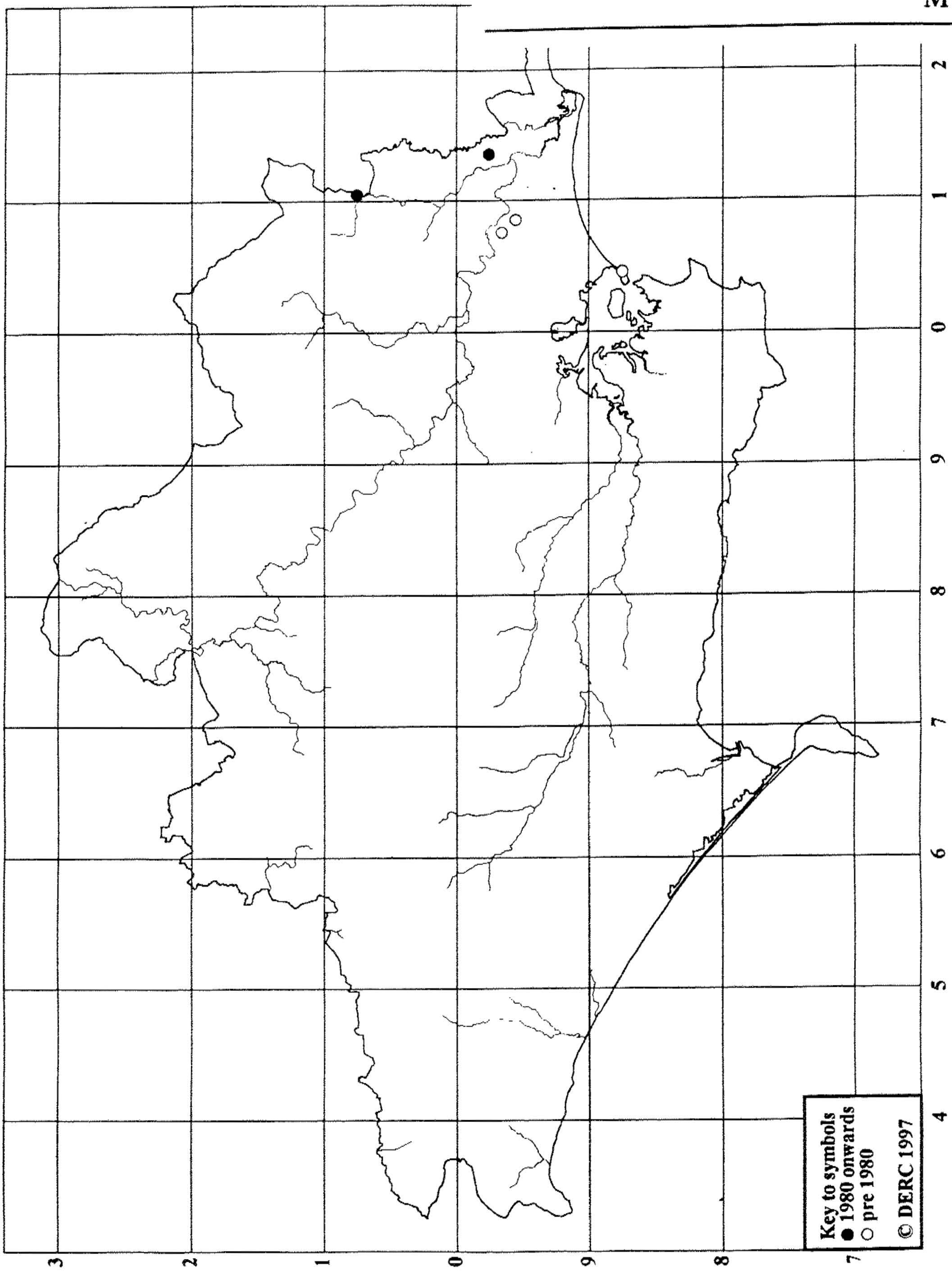
Distribution of Teesdalia nudicaulis in Dors

Map 30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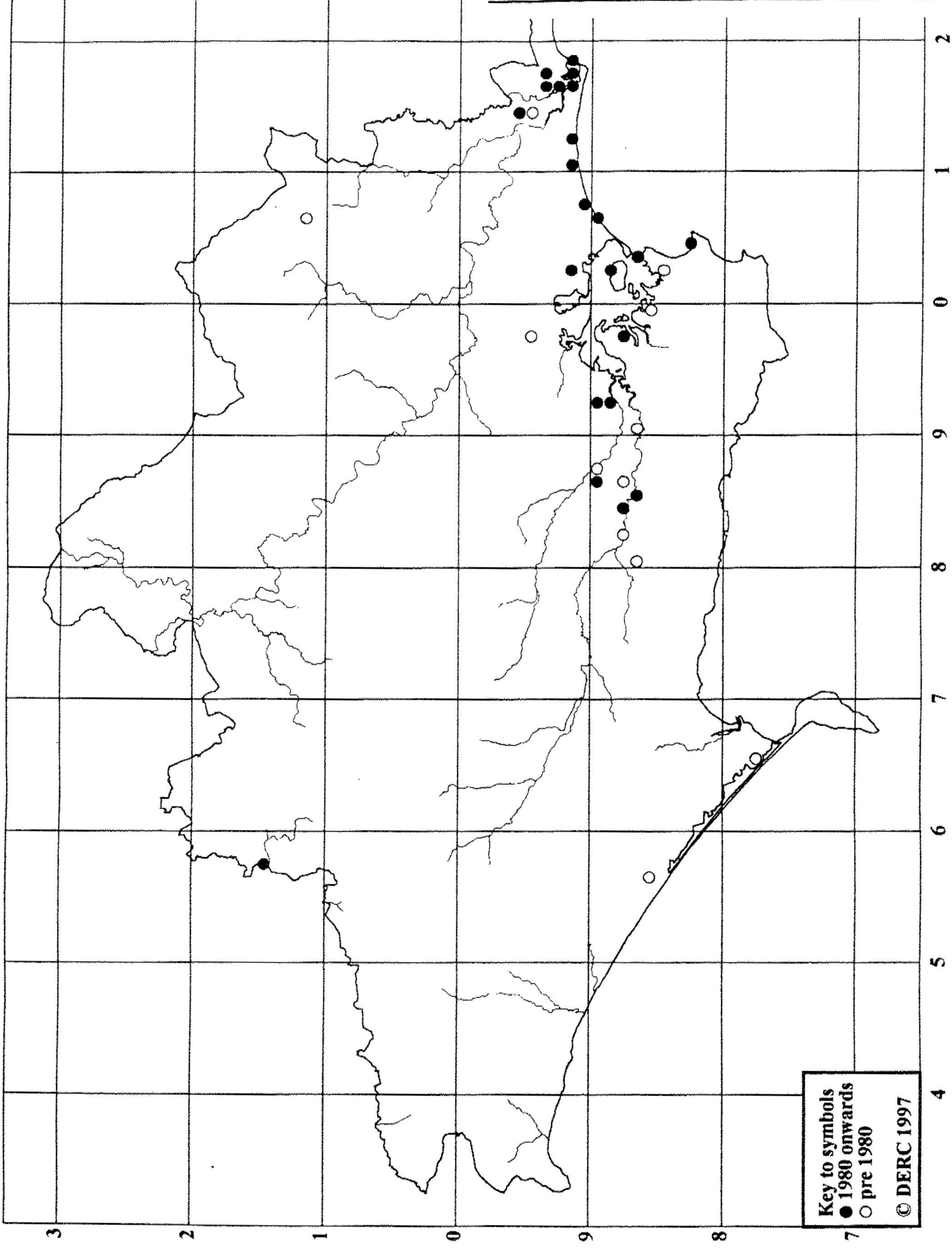
Distribution of Trifolium glomeratum in Dorset Map 31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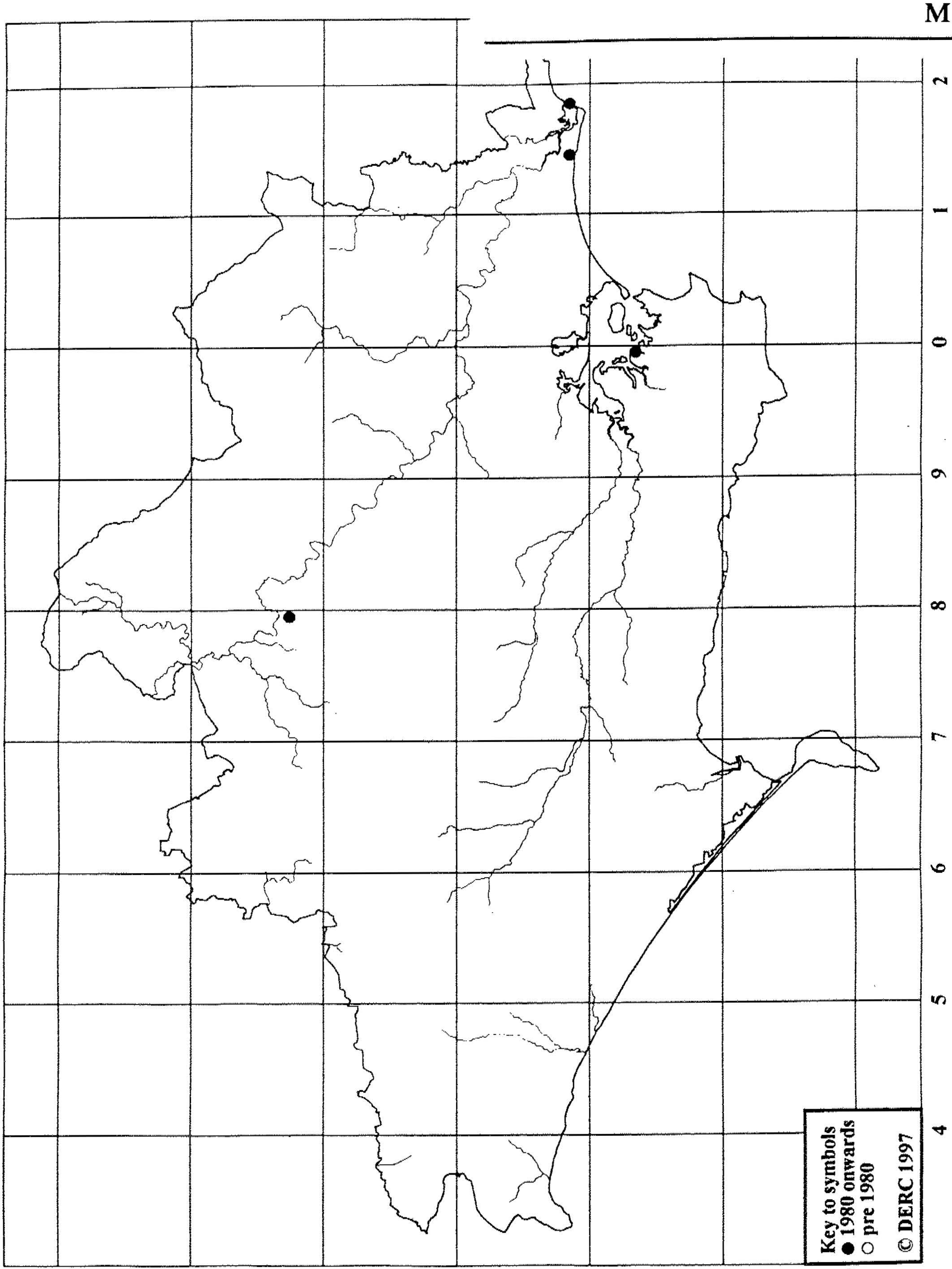
Distribution of Vicia lathyroides in Dorset

Map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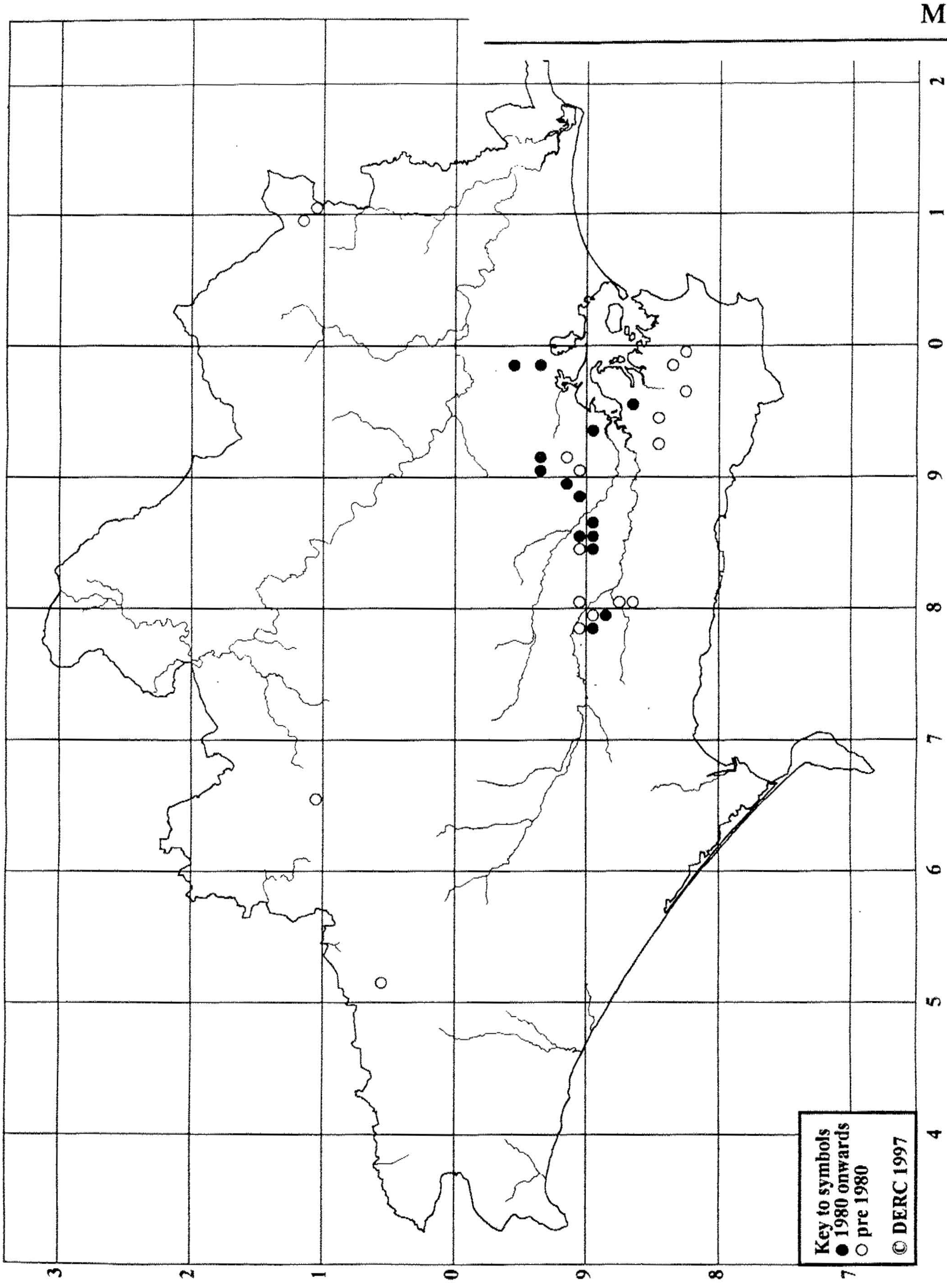
Distribution of Viola lactea in Dorset

Map 33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13. Essex

13.1 Physical

Geology

The solid geology of Essex is buried by drift over about half of the county. Chalk outcrops in the far north west, whilst ridges of Tertiary sand and clay outcrop in the south and east. The north western half of the county is dominated by boulder clay, but gravels of various sorts also occur here, and gravels are extensive in the south and east.

Soils

Dry acid soils are not recorded as abundant within Essex according to the soil association map (**Map 1b**).

13.2 Landscape history

19th Century

In the early 19th century unenclosed heathlands were scattered through the east of the county, especially on the Tertiary ridges. In the south there were several large pasture woodlands including Epping Forest.

Current landscapes and Natural Areas

English Nature divides the county between the East Anglian Plain (NA50) to the north and the London Basin (NA66) to the south. The London Basin includes the surviving Epping Forest and small relics of the eastern heaths, and also includes the areas of lighter soils around Colchester, which have a few relics of former heaths. The coastal edge is within the Greater Thames Estuary Natural Area (NA67).

13.3 Existing information

Flora

The coincidence maps of the lowland acid grassland species listed in **Table 1** (**Maps 2** to **4**) show that there were concentrations of these species between Colchester and Chelmsford but that these have suffered considerable decline. In contrast, Epping Forest appears to have always been species-poor.

There are two modern floras covering all or parts of the county (Jermyn, 1974 and Tarpey & Heath, 1990). These record a total of 17 acid grassland species of which 6 appear to be extinct (**Table 6** and extract below). In the species accounts, gravel pits are often mentioned, and indicate that these may be a significant reservoir of habitat for species with better dispersal capabilities. Sites frequently mentioned include the Roman River area (TM0715), Tiptree Heath (TL8814) Fingringhoe (TM0715) and Danbury Common (TL7804). The possible native, *Filago gallica*, was last recorded in a gravel pit in the Colchester area and was reintroduced by Plantlife and EN in 1995. The nationally scarce *Scilla autumnalis* has been recorded from parched acid grassland on gravel terraces near the Thames.

Fauna

No published data were consulted but the English Nature Local Team reported that a recent addition of the 'Essex Naturalist' has an extensive review of the Aculeate Hymenoptera which are often an important element of dry grassland fauna. This review and contract work by Colin Plant for English Nature shows that the Thames Terrace Gravels are very important for invertebrates.

Habitat surveys

The Grassland and Heathland Inventories note only small relic areas of acid grasslands and heath. The Heathland Inventory notes the presence of tiny amounts of lichen heath which may represent stands of U1a. The maps in the NVC, Volume 3, show that U1b, U1d and U1e were sampled from the county in the Chelmsford-Colchester area (Rodwell, 1992).

In his detailed description of the remarkable pasture woodland established on the boulder clay of Hatfield Forest, Rackham (1989) describes the survival of a small area of parched acid grassland (U1) in old gravel workings, including *Moenchia erecta* in one of its few surviving sites in East Anglia. The description also includes the local moss *Rhodobryum roseum* (Rackham, 1989).

The shingle survey (Sneddon & Randall, 1994) also suggests the presence of small areas of grassland close to or synonymous with U1 in shingle sites on stable parts of shingle structures.

Summary of consultations with Local Team Conservation Officers

The extent of acid grassland was estimated as covering between 100-500ha, possibly more. This is mostly parched acid grassland (U1) with some Deschampsia flexuosa grassland (U2). These grasslands are found in the east and south, on periglacial ridges and glacial out-wash, and occur from Epping Forest to Dunbury, Triptree, Colchester and Basildon to Rochford and the Dengie Hills. Most are relics of heathland. Very small areas occur within grazing marshes on sand ridges and ant hills. They can be important invertebrate sites where there are bare ground and vegetation mosaics. As with heaths, areas of acid grassland are often unmanaged.

13.4 Summary of resource

Extent and composition

Given the degree of habitat loss in Essex, EPR doubts that there is much more than 500ha of lowland acid grassland in Essex. Surviving areas appear to be a typical eastern mixture of parched acid grassland (U1b, U1d & U1e) with some Deschampsia flexuosa grassland (U2) in relic habitats. The richest acid grassland is confined to the area between Chelmsford and Colchester. It is thought that rather different grasslands survive on the Thames Terraces but there is little information about them.

Conservation value

The remaining areas of lowland acid grassland in Essex are still of considerable nature conservation value, both at a county level, and in the context of south east England.

13.5 Future requirements for survey and conservation

Survey

The English Nature Local Team regards the London Basin as a relatively high priority for survey, with the other areas of lower priority. In a national context, the area between Chelmsford to Colchester and the Thames Terraces probably have the highest priority for survey.

Conservation

The lowland acid grassland of Essex suffers from considerable problems of neglect and habitat degradation. The heaths and acid grassland relics of the Chelmsford to Colchester area have the greatest priority for restoration and the creation of new habitat. The heathland in this area has probably always been richer in dry grassland species than elsewhere in the county, although the heathlands to the south may be wetter and have with a different range of species. This is likely to be the case in Epping Forest.

13.6 References

JERMYN, S.T. 1974. *Flora of Essex.* Colchester: Essex Naturalists' Trust.

RACKHAM, O. 1989. *The last forest: the history of Hatfield Forest.* London: J.M. Dent and Sons.

SNEDDON P. & RANDALL, R.E. 1994. *Coastal vegetated shingle structures of Great Britain: Appendix 3. Shingle sites in England.* Peterborough: Joint Nature Conservation Committee.

TARPEY, T. & HEATH, J. 1990. *Wild flowers of north east Essex.* Colchester: Colchester Natural History Society.

Extract from Table 6 for Essex: occurrence of plant species generally faithful to lowland acid grassland

County: Essex	
Natural Areas:	**All**
Grasses	
Apera interrupta	0
Other Vascular Plants	
Chamaemelum nobile	0
Filago minima	1
Hypochaeris glabra	0
Medicago minima	0
Moenchia erecta	1
Ornithopus perpusillus	1
Potentilla argentea	1
Stellaria pallida	1
Teesdalia nudicaulis	0
Trifolium glomeratum	1
Trifolium ornithopodioides	1
Trifolium scabrum	0
Trifolium striatum	1
Trifolium subterraneum	1
Trifolium suffocatum	1
Vicia lathyroides	1
Total no. of species extant	**11**
Total no. of species extinct	**6**
Total no. of species recorded	**17**

1 = Recent record
0 = Apparently extinct

Essex acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1985-90	Common, Field, Pasture woodland	Only small amounts noted	8	1539.6	3.5	3.5		
Heathland Inventory		1984-95	Common, Waste	Epping Forest and small patches beyond	20	2628.0			33.9	0.2
Estimates, classes		1996	Plus Parkland	Stephen Ayliffe, English Naure				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Estimates, class	C	?	+		+	+		A														

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

14. Gloucestershire

14.1 Physical

Geology

East of the River Severn, Gloucestershire is composed of Jurassic deposits with Oolitic Limestone forming the dramatic scarp of the Cotswolds. To the west, New Red Sandstone, Old Red Sandstone and Carboniferous rocks occur.

Soils

The largest block of acid soils recorded are brown podzolic soil associations in the Forest of Dean. Elsewhere there are small areas of brown sands north of Newent (**Map 1b**).

14.2 Landscape history

19th Century

In the 1830's the 'rolling enclosure' of the Forest of Dean had not been completed and areas of open heathland and pasture woodland still survived. However, at this point in time, the Forest of Dean was already more enclosed than the New Forest in the 1870's, when the practice of enclosure was finally halted in the New Forest. Since then, virtually all of the Forest of Dean has been included within timber enclosures.

Current landscapes and Natural Areas

Gloucestershire is divided into three Natural Areas: the limestone-dominated Cotswolds (NA55), the low lying plain of the Severn and Avon Vales (NA56) and the varied undulating landscape of the Dean Plateau and Wye Valley (NA61). Only the latter contains any potential for the widespread occurrence of acid grasslands.

14.3 Existing information

Flora

The coincidence maps of the lowland acid grassland species listed in **Table 1** (**Maps 2** to **4**) show that there was a moderate concentration of these species in the Forest of Dean but that they have declined considerably. A total of 10 species are recorded, of which 4 appear to be extinct (**Table 6** and extract below).

Habitat surveys

The Grassland Inventory reflects the efforts of the Forest of Dean grassland survey (Regini 1995; Doe 1996) but also records the presence of a few acid grasslands beyond NA61, eg Brockeridge Common (SO83) in the Severn Valley (NA56) and Cleeve Common on the highest part of the Cotswolds (NA55). The Heathland Inventory reflects the completeness of enclosure in the Forest of Dean, recording only tiny fragments of heathland.

Forest of Dean grassland survey (Regini 1995 & Doe 1996)

The detailed Phase 2 survey of the Dean Plateau and Wye Valley Natural Area (NA61) (Regini 1995 & Doe 1996) records an area of acid grassland of approximate equal size (just over 100ha) to that of herb-rich neutral grassland (MG5). Both parched acid grassland (U1) and moist acid grassland (U4) were recorded but the former was more frequent. The acid grasslands are concentrated on the areas where podzols and brown sands are recorded as dominant on the soil map (**Map 1b**).

The two most frequently recorded sub-communities of parched acid grassland were the heathy Galium-Potentilla sub-community (U1e) and the more base rich Anthoxanthum-Lotus sub-community (U1d). Rarely recorded sub-communities included the Typical sub-community (U1b), the Hypochaeris sub-community (U1f) and fragmentary stands, possibly Erodium-Teesdalia sub-community (U1c), on coal waste tips. Selected data from the survey of May Hill SSSI are presented in Volume I, Appendix 1, as an illustration of U1e grassland in enclosed pasture.

The sub-communities of moist acid grassland (U4) recorded include Typical sub-community U4a, Holcus-Trifolium sub-community (U4b) Lathyrus-Stachys sub-community (U4c), presumably as a transition to MG5c, and the Luzula-Rhytidiadelphus sub-community (U4d). Most were found in fields but relics of the open Forest vegetation and vegetation on coal mine waste were also seen. Interestingly, transitions from acid grasslands to calcicolous grassland (Festuca-Pilosella-Thymus grassland, CG7) are recorded on Carboniferous Limestone.

Fungi in the Patches (Rotheroe, 1995)

In an article on unimproved grassland fungi (Rotheroe, 1995), mention is made of 'The Patches', a 3.7ha area of ancient grassland in the Forest of Dean which is one of the richest grasslands for fungi so far recorded. This area was surveyed by Regini (1995) (Moseley Green) and was found to be predominantly a mixture of moist acid grassland (U4) and *Nardus* grassland (U5).

Summary of consultations with Local Team Conservation Officers

The acid grasslands of the Forest of Dean are well described by Regini (1995) and Doe (1996). They are concentrated on the central Forest of Dean and are found in mosaic with other grasslands, especially calcicolous grassland and mires, with distinctive stands developed in industrial waste sites. The sites are mostly small and the individual quality is not high, but they represent relics of habitats which were once widespread in the Forest. There is a need to restore the diversity of the habitat mosaic in the Forest of Dean. To the east of the county, acid grassland is very rare and occurs in a few sites where the communities present remain undefined. The area present totals less than 10ha in all.

14.4 Summary of resource

Extent and composition

The acid grasslands of the Forest of Dean are an integral part of the unimproved grasslands there, and mostly survive in small fields and relic commons. They probably represent a typical western mixture of parched acid grasslands (U1d & U1e) on shallow soils with moist acid grassland (U4) present on less droughty soils.

Conservation value

The acid grasslands are best assessed as part of an unimproved grassland complex. Considered alone, though interesting, they are not floristically outstanding, with the exception of their important fungi flora.

14.5 Future requirements for survey and conservation

Survey

The completion of the Forest of Dean survey has left no priorities for survey, but the value of acid grasslands for fungi needs further investigation.

Conservation

Restoring the habitat diversity in the Forest of Dean is a priority consideration and can be achieved with the restoration of heath, mire and pasture woodland as well as acid grassland. The New Forest is a directly relevant model given its similar history, legal status and ownership.

14.6 References

REGINI, K. 1995. *Forest of Dean grassland survey 1994.* Stonehouse: Gloucestershire Wildlife Management Ltd.

DOE, J. 1996. *Forest of Dean grassland survey 1995.* Stonehouse: Gloucestershire Wildlife Management Ltd.

ROTHEROE, M. 1995. Saving an historic lawn: conservation progress report. *Mycologist,* **9**: 106-109.

Extract from Table 6 for Gloucestershire: occurrence of plant species generally faithful to lowland acid grassland

County: Gloucestershire	
Natural Area:	**61**
Chamaemelum nobile	0
Filago minima	1
Moenchia erecta	1
Ornithopus perpusillus	1
Potentilla argentea	1
Trifolium ornithopodioides	0
Trifolium scabrum	0
Trifolium striatum	1
Trifolium subterraneum	1
Viola lactea	0
Total no. of species extant	**6**
Total no. of species extinct	**4**
Total no. of species recorded	**10**

61 = Dean Plateau and Wye Valley

1 = Recent record
0 = Apparently extinct

Gloucestershire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1988-95	Field, Enc. relic, Waste, Common	Mainly in NA 61 (see below)	35	688.0	521.6	39.1		
Heathland Inventory		1983-89	Encosure relic & Common	Fragments in NA61 & Cleeve Common NA55	3	484.0			4.4	
Forest of Dean Ph2		1994-5	Field, Enc. relic, Waste, Common	Detailed Phase 2 (Regini, 1995 & Doe, 1996)	37			113.1		
Estimates, classes		1996		Mike Wilkinson, English Nature				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Forest of Dean Ph2	73.3		+	+	+	+	+					39.0	+	+	+	+		1.5				
Estimates, class	B		A	?	A	A	A					A	A	A	A	A		A				

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

15. Greater London

15.1 Physical

Geology

Virtually all of the London area is underlain by Tertiary sands and clays but drift and alluvium often mask these deposits, especially on river terraces. In the south an outcrop of Chalk occurs where the North Downs dip slope rises above the London Basin.

Soils

In the south of London several of the larger open spaces are dominated by podzolic soils (**Map 1b**).

15.2 Landscape history

19th Century

In the early 19th century there were still sizeable heathlands south of the River Thames.

Current landscapes and Natural Areas

Most of London is within the London Basin Natural Area (NA66). Although the Area is now occupied by one of the world's largest conurbations, former heathland and parklands have survived as public open spaces as a result of their status as commons or Royal Parks. On the urban fringes, golf courses provide other areas where relic semi-natural vegetation survives.

15.3 Existing information

Flora

The coincidence maps of the lowland acid grassland species listed in **Table 1** (**Maps 2** to **4**) show that there were high concentrations of characteristic lowland acid grassland species south of the Thames, but unsurprisingly, that there have been massive declines. The nationally scarce *Scilla autumnalis* occurred in parched acid grasslands on gravel terraces along the Thames and is still found in Hampton Court Park.

Habitat surveys

The Grassland Inventory picks out the very large Richmond Park and the smaller Bushy Park as containing areas of acid grassland, with the rest occurring as smaller fragments.

Williams (1993) carried out a Phase 2 survey of 11 sites but did not survey the 847ha Richmond Park. He found 180ha of acid grassland with parched acid grassland dominant. The main sub-community was the Typical sub-community (U1b) but the Anthoxanthum-Lotus (U1d) and the Galium-Potentilla (U1e) sub-communities occurred in significant quantities. Only a very little Deschampsia flexuosa grassland (U2) was recorded. This was said to be the upland Vaccinium sub-community (U2b) but this unlikely. More likely is a transition to woodland (W16) or Bracken (U20b). Little indication of the floristic diversity of the sites was given. Old gravel workings at the Chase Nature Reserve included 22ha of U1 but this was species poor.

Summary of consultations with Local Team Conservation Officers

It is considered that there are between 500-1,000 hectares of acid grassland in London with most in Richmond Park. Dr Francis Rose thought that Addington Hills still had a rich acid grassland flora, and this view should be balanced against the views of Williams (1993), that Addington was not a high quality site. He also described Keston Common (TQ4264) as containing rich, rabbit grazed, and trampled acid grassland with *Potentilla argentea*, *Trifolium arvense*, *Trifolium glomeratum* and *Trifolium striatum*. Again, this was not mentioned by Williams. Acid grassland often occurs in association with veteran trees, an important feature of the London Basin, in sites such as Richmond Park.

15.4 Summary of resource

Extent and composition

In spite of the massive urban expansion that has occurred in Greater London, significant areas of parched acid grassland with a typical mixture of U1b with U1d and U1e, still remain. However, available data indicates that this grassland is now rather species poor.

Conservation value

The most significant grasslands are probably those in Richmond Park, as part of a well-preserved, ancient, deer park. The grasslands themselves are probably of little more than London significance.

15.5 Future requirements for survey and conservation

Survey

It would be useful if the areas not surveyed by Williams (1993) were covered, but this is not considered a high priority.

Conservation

There are presumably opportunities for extending acid grassland habitats in areas of scrub and heaths, and old gravel workings. However, the likely problems of grazing this grassland makes this a low national priority.

15.6 References

WILLIAMS, P.R. 1993. *Phase 2 survey of acid grassland and heathland in Greater London 1993.* Wye: English Nature.

Greater London acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1986-93	Park, Enc relic, Common, Waste drift/calc	Mainly in old parks and heathland relics	15	2672.2	199.8	182.0		
Heathland Inventory		1984-93	Park, Enc relic, Common	Mainly in old parks and heathland relics	19	2350.0			123.9	
Williams (1993)		1993	Enc relic, Common	Excludes Richmond Park & Wimbledon Com.	11	1443		180.0	23	
Estimate, classes		1996		Neil Sanderson, EPR				D		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Williams (1993)	179.0		93.0		41.0	45.0		1.0		1.0												
Estimates, class	D		+		+	+		A		?												

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

16. Greater Manchester

16.1 Physical

Geology

Manchester is located on Coal Measures to the north and east, and New Red Sandstone to the south and west. The Millstone Grit uplands are included in the extreme east of the area. Much of this part is covered with glacial drift.

Soils

Upland soils occur in the extreme east, whilst in the lowlands, sizeable patches of brown sands exist (**Map 1e**).

16.2 Landscape history

19th Century

In the early 19th century the landscape included sizeable raised mires and small areas of heathlands.

Current landscapes and Natural Areas

The area is part of English Nature's Urban Mersey Basin Natural Area (NA26), which is now occupied by a major urban conurbation. The Southern Pennines Natural Area (NA14) fringes the northern part of the county.

16.3 Existing information

Flora

The coincidence maps of the lowland acid grassland species listed in **Table 1** (**Map 2** to **4**) show that few of these species have been recorded in the county.

Habitat surveys

The Grassland Inventory indicates that acid grassland has been recorded quite frequently across the urban area, in both urban fringe sites and in the upland fringe. The Grassland Inventory records a total of 68 sites covering 475ha from which acid grassland has been recorded but gives no indication of how much of this is actually acid grassland. The Heathland Inventory records small areas of relic heathland, mainly to the north east.

During EPR work in Greater Manchester (Colebourn, 1994b) *Deschampsia flexuosa* (U2) and *Nardus* (U5) grasslands were observed in the drier parts of remaining unimproved grasslands, and parched acid grasslands (U1e & U1f) seen on disturbed areas or very steep and dry sites.

Summary of consultations with Local Team Conservation Officers

The Local Team confirmed that Greater Manchester has between 10 to 100ha of acid grassland. The bulk is in the uplands bordering the Urban Mersey Basin Natural Area and acid grassland is restricted in the lowlands, where it occurs with heathland. Small patches of acid grassland also occur on boiler-ash waste areas in Nob End SSSI.

16.4 Summary of resource

Extent and composition

There appears to be between 10 to 100ha of acid grassland in the Greater Manchester area, but much may be upland or upland fringe. From what observations have been made, a combination of U2 and U5, with U1 in disturbed areas, appears to dominate in the lowlands but U4 can be expected to occur.

Conservation value

Acid grasslands in Greater Manchester are likely only to be of value in a county context.

16.5 Future requirements for survey and conservation

Survey

No national priorities, though the acid grassland fringes of the Southern Pennines Natural Area (NA14), which borders the county, have been identified as a local priority for survey (Colin Newlands, pers. comm).

Conservation

No national priorities.

16.6 References

COLEBOURN, P.H. 1994b. Thameside UDP Public Inquiry Feb-March 1994. Proof of Evidence on Ecology by P.H. Colebourn, MA, MSc, MRTPI, MIEEM. Winchester: Ecological Planning and Research.

Greater Manchester acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1988-91	Field, Waste, Enclosure relic	Includes urban fringe and upland edge sites	68	475.1	27.0	NI		
Heathland Inventory		1980-92	Field, Mire	Mainly in north and east	41	964			50.1	
Estimates, classes		1996		N. Sanderson, EPR				B		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Estimates, class	A					A	A	A				A?						A				

Key

Column headings

GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates

A = Less than 50 ha
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C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

17. Hampshire

17.1 Physical

Geology

Three areas of sands and clays predominate, separated by the Chalk hills of central Hampshire. In the south, the Hampshire Basin contains Tertiary sands and clays, with the London Clay much less predominant than in the Thames Basin as a whole. The Hampshire part of the Thames Basin however, includes only limited amounts of London Clay, and a great deal of Bagshot and Bracklesham Beds. In both areas, gravel terraces (Plateau Gravels) are important features. In the south there are sand dune systems on the south coast of Hayling Island and very sandy areas with ancient sand dunes and inland blow outs on the lower terraces of the River Avon, west of the New Forest at Bistern Warren. The western Weald forms the third area, and is very different, with the sand-dominated Lower Cretaceous Lower Greensand being particularly well exposed.

Soils

In the New Forest and south east Hampshire, podzol-dominated soil associations are largely restricted to Plateau Gravels, with surface-water gleys dominating elsewhere. In the Thames Basin, areas dominated by podzols are confined to ridge tops to the west but are more widespread in the north east. The Lower Greensand of the western Weald supports podzol-dominated soils under heathland and former heathland areas, with brown earths dominant under enclosed land (**Map 1b**).

17.2 Landscape history

19th Century

The landscape depicted on the 1 inch OS maps of the 1810's is, with a few exceptions, little changed from the medieval period. The New Forest stood out, even then, as an immense area of open heathland and pasture woodland, but it still had many attached commons which are now enclosed. To the east the rest of the Hampshire Basin had large areas of heathland and pasture woodland, now almost entirely lost. In the north there were scattered, medium-sized, commons to the west and extensive coalescing heaths in the north east. Finally the western Weald was dominated by large blocks of almost treeless heathland on the Lower Greensand.

Current landscapes and Natural Areas

English Nature divides the Hampshire Basin into the New Forest Natural Area (NA77) with its extensive surviving heathland and pasture woodlands and the South Coast Plain and Hampshire Lowlands (NA75), where most of the heathlands have been enclosed and destroyed but coastal habitats with heath and acid grassland still survive.

The whole of the Thames Basin is included in the London Basin Natural Area (NA66). However, the heathland areas of north east Hampshire and its neighbouring counties, where heathland was the dominant historic land use, are very different to the rest of the Thames Basin, where heathland was always a subsidiary land use. The Lower Greensand heathlands are included within the Wealden Greensand Natural Area (NA70).

17.3 Existing information

Flora

The coincidence maps of the lowland acid grassland species listed in **Table 1** (**Maps 2** to **4**) show that there were high concentrations of characteristic lowland acid grassland species in the New Forest, the south east coast, the western Weald and the north east of the county. All these areas are still of interest, with the lowest rate of decline present in the New Forest area. Lists of the species in each area are given in the extract of **Table 6** below. The New Forest also contains a major concentration of ephemeral pond species characteristic of acid grassland sites (**Maps 5** to **7**), whilst the western Weald holds a concentration of species typical of disturbed acid soils (**Maps 8** to **10**).

The recent Flora of Hampshire (Brewis et al, 1996) allows a detailed analysis of the acid grassland flora of the county. A total of 23 acid grassland species have been recorded, all of which remain extant - a unique feature in England. The highest total is recorded from the New Forest area (including the New Forest proper and the Avon sand terraces, but excluding the coast) with 21 extant species recorded.

The dry acid grassland species are mainly confined to the plateau gravels across the New Forest and to sands in the west of the Forest, with rich outliers on the Avon terraces. The species present include all the remaining colonies of Wild Gladiolus, *Gladiolus illyricus*, a major proportion of the British population of *Chamaemelum nobile* (Winship, 1993), *Carex montana* and *Viola lactea*. A rich clover flora is widespread, along with species such as *Sagina subulata* and *Moenchia erecta*.

More localised to the west on sands, and the Avon sand terraces, are species such as *Carex arenaria, Crassula tillaea, Hypochaeris glabra, Teesdalia nudicaulis* and *Vicia lathyroides*. As well as the 21 characteristic species, 33 of the locally characteristic species are present (**Table 2**) giving an overall total of 53 species on the provisional acid grassland indicator list (**Table 8**). This is likely to be the highest total from any single tract of semi-natural vegetation, perhaps because elsewhere heathlands have suffered greater fragmentation.

A distinctive feature of the New Forest acid grasslands is the scattered occurrence of calcicole species including frequent *Cirsium acaule* and *Carlina vulgaris* and, less often, species such as *Brachypodium pinnatum* and *Scabiosa columbaria*. These occur, along with species such as *Botrychium lunaria* and *Gentianella campestris*, in acid grasslands created by war time or post-war disturbance of heathland through either air field construction or temporary arable cultivation.

Other features include abundant *Agrostis curtisii* in grassland and heathland, and herb-rich Bracken. Species present in the latter include a mixture of pasture species such as *Succisa pratensis, Stachys officinalis* and *Serratula tinctoria*, and woodland species such as *Anemone nemorosa, Hyacinthoides non-scripta* and *Convallaria majalis* as well as the spectacular *Gladiolus illyricus*.

The next richest area is the coastal grasslands in the south east, where acid grassland occurs in shingle and sand dune systems. A total of 21 species have been recorded but 3 are apparently extinct. Species here include *Sagina subulata* at Hayling Island, one of the few remaining sites for this species outside the New Forest, and *Silene nutans* on Browndown shingle beach. *Agrostis curtisii* still occurs in some relic inland heaths.

The western Weald is also notable, with 18 species recorded, one of which is apparently extinct. Here the Woolmer area is picked out as being especially rich. Species such as *Carex arenaria, Hypochaeris glabra, Teesdalia nudicaulis* and *Vicia lathyroides* are much more prominent than in the New Forest. *Herniaria glabra* has been found since the Hampshire Flora was published (F. Rose, pers com.).

Conversely, species such as *Chamaemelum nobile* and *Moenchia erecta* are rare. *Agrostis curtisii* is exceptionally rare.

The heaths of north east Hampshire are less spectacular. Fourteen species have been recorded of which two are apparently extinct and many of the surviving species are in a perilous situation. *Agrostis curtisii* occurs locally.

Finally, data for the Hampshire Chalk indicates the presence of limited areas of acid soils from which a total of seven species have been recorded, of which two are apparently extinct.

Fauna

The New Forest has one of the most important invertebrate faunas in Britain, although little data exists on the relative role of acid grassland and associated herb rich Bracken stands as invertebrate habitat. Most probably the value of acid grassland is high, as virtually all the long-lasting, bare, sandy ground is associated with acid grassland. The Grayling Butterfly (*Hipparchia semele*) is especially strongly associated with *Agrostis curtisii* grasslands and heaths (U3 and H3).

In the New Forest, the acid grassland bird fauna includes Woodlark, which nests semi-colonially on short heath and in large areas of acid grassland, associated with past disturbance. In the grasslands it often nests in the shelter of Bracken litter. Five to ten pairs of Ring Plovers also nest on acid grasslands, which are associated with disused war time air fields, in the north of the New Forest.

The Forest grasslands support one of the largest surviving Wheatear populations in the lowlands, and a small Whinchat population still breeds in the north west of the New Forest, in areas of mixed Bracken, acid grassland, Gorse and heath. Stonechat use Gorse in both acid grassland and heath, but Dartford Warblers tend to be much more strictly confined to the latter habitat (Clark & Eyre, 1993 & Gibbons *et al* 1993).

Nightjars may use open Bracken litter in grassland on the edge of pasture woodlands. Finally Stone Curlew has been recorded in the area, but is unlikely to breed due to high levels of disturbance by the visiting public. It is thought that the nesting success of ground nesting birds is being affected by predation and disturbance by domestic dogs.

Beyond the New Forest, Wheatear, Whinchat, Ring Plover and Stone Curlew are absent from heathland. The other species all occur in heathlands but are less likely to use acid grassland and open Bracken due to its poor condition, but Woodlark uses mown acid grassland in Woolmer and north east Hampshire. In contrast, the use of open Bracken litter in the New Forest, by species such as Woodlark, appears to be associated with winter grazing of the Bracken/grass mixtures, producing a more attractive habitat by trampling down of the litter.

Habitat surveys

The Grassland Inventory gives an unbalanced picture of the distribution of acid grassland because of the lack of information for most heathland and coastal sites. Most of the sites recorded are predominantly neutral grassland or fen meadow, with small patches of acid grasslands on banks or anthills. Some sites included do not actually have any dry acid grassland; acid MG5c or acid fen meadow (M23a, M24c or M25b) all appear to have been described as acid grassland. The Inventory does not, as yet, include mires but M22, M23a, M24c and M25b probably form over 50% of the enclosed unimproved grassland in Hampshire when taken together.

The only sites with extensive acid grasslands recorded in the Inventory are commons and former warrens along the eastern edge of the Avon flood plain and the New Forest. Some have been surveyed to a Phase 2 level but no report is available. An example, surveyed by the contractor, is described in Volume I, Appendix 1. They differ from the parched acid grasslands of the New Forest in the dominance of U1b and the abundance of *Carex arenaria* in this community. One site, a former daffodil field that has reverted to grassland, supports a small fragment of the rare U1c with *Crassula tillaea.*

New Forest grasslands (Westerhoff, 1992)

The vegetation of the common grazings of the New Forest has been mapped at 1: 10,000 scale using a customised classification (Westerhoff 1992). Its treatment of grasslands is based on a classification of landscape and management, due to the lack of suitable grassland classification at the time of survey. An attempt was made to correlate this with the NVC after the survey.

The 19773.8ha of rough grazing in the New Forest was found to contain 3299.36ha of grassland including mixtures with Bracken, along with 1823.84ha of Bracken (both may include species-rich Bracken stands) and Bracken/Gorse mixtures; 5848ha of dry and humid heath, including mixtures with Gorse; 2662ha of wet heath; 1492.32ha of mire and 4545.2ha of pasture woodland.

The grassland landscape/landuse units used by Westerhoff (1992) are estimated very roughly from personal experience (NA. Sanderson, EPR) to consist of the following communities:

- All combinations with acid grassland = 25% U3, 25% U1, 25% Wet Lawn (*Junco-Molinion* only) and 25% U20.

- Reseeded grassland and partly improved grassland = 90% U1d and 10% MG6b.

- Lawn = 60% wet lawn (*Junco-Molinion* only), 20% U1 and 20% MG6b.

The New Forest grasslands can be divided into the following broad NVC based categories which have been proposed to replace the original sub-divisions in any re-mapping of the Forest (Westerhoff 1992). Examples from categories covering dry acid grassland, as well as an example of species-rich Bracken, are given in Volume I, Appendix 1. Selected quadrat data and community lists are presented there, together with brief site descriptions.

- Heathy acid grassland

  This extends to about 1100ha and is mostly composed of *Agrostis curtisii* grassland (U3), representing the bulk of the *Nardo-Galion* swards in the New Forest. This grassland type develops mainly on old acid brown earths, as opposed to the podzols found under heath, but is rarely found on soils disturbed this century. No U2 grassland exists.

- Parched acid grassland

  The U1 grasslands of the New Forest. These are mainly found on fairly recently disturbed soils and cover about 1000ha. Of the sub-communities, U1f is most frequently found, except in the extensive 'brecks' created by war time and post-war disturbance and cultivation of heath. On these soils a rich vegetation has developed containing a mixture of both U1f and U1d species. For convenience these are described as U1d. U1d occupies about 600ha and U1f less than 400ha. Small areas of U1b, and U1e occur on localised areas of freely draining sands. Very locally, small strips and patches of U4 grasslands develop in the transition zone between wet lawn and parched acid grassland and in shaded glades in the pasture woodlands.

- Lawn

  Lawn has been redefined to cover only the *Junco-Molinion* wet acid grasslands, including undescribed *Agrostis canina-Carex panicea* flood pasture related to M24c and M16b, as well as more typical patches of M23a, M25b, M24c and short M16b.

- Green

  This covers the grassland on enriched soils which contain *Cynosurus*. It appears to be a distinctive variant of MG6b, with frequent *Chamaemelum nobile* (Sanderson & Colebourn, 1992), and often forms mosaics with U1f.

Heathlands

A detailed inventory is being compiled by Paul Edgar of the Hampshire Heathland Project from unpublished surveys. This will cover acid grassland but was not available at in time to incorporate into this report. It is hoped that the information can be used to update the Heathland Inventory for the County. Two Phase 2 surveys covering part of the Lower Greensand heathlands have been published and these are discussed first.

Woolmer Forest (Sanderson & Colebourn, 1993 & Sanderson & Stanbury, 1996)

Both of these surveys were carried out to assess the impact of road proposals on heathland. The heathlands on the Folkstone Sand of the Lower Greensand around Woolmer Forest and Bordon were surveyed. The heath itself is unusual. Over much of the area H2a dominates but locally H1b becomes prominent. Acid grassland is restricted to parched acid grassland (U1); *Deschampsia flexuosa* grass heath (U2) is absent, possibly due to high levels of rabbit grazing. The most widespread acid grassland is the Typical sub-community (U1b), with *Carex arenaria* locally abundant, as at Shortheath Common (SU7736). Other species of interest include *Chamaemelum nobile* and *Trifolium ornithopodioides*. These grasslands have mainly developed on areas of past disturbance, but which now carry fairly closed, rabbit grazed, swards. At Shortheath, grazing by tethered horses supplements the rabbit grazing.

Additional communities are confined to the corridor of the old military railway (SU7931 to 7832) where repeated heavy disturbance has produced a mix of communities more typical of East Anglia. Areas which have not been recently disturbed support lichen-rich acid grassland (U1a), with 1.6ha recorded. This grassland has a high diversity of lichens, with a mean of 19 species per stand and 10.2 per quadrat. This contrasts with figures of 1.9 species per stand and 1.6 per quadrat in the Suffolk Breckland (Smith & James 1995 and Smith, 1996). Species of interest include *Cladonia foliacea*.

Repeatedly disturbed sites supported 0.6ha of the rare Erodium-Teesdalia sub-community (U1c). Species of interest recorded from this species-rich community include *Hypochaeris glabra* and *Vulpia ciliata ambigua*. A little U1d was noted and some little rank *Carex arenaria* vegetation (SD10) has developed where rabbit grazing is low. A patch of Carex arenaria-Cornicularia community (SD11) has developed on disturbed sand. Selected data from the disturbed heathland edge is presented in Volume I, Appendix 1, to illustrate the characteristics of this type of acid grassland.

The grasslands near Woolmer Pond are very species rich; 135 species were recorded from U1 stands of which of 11 were lowland acid grassland species (**Table 1**) and a further 16 are in the list of locally characteristic species (**Table 2**) giving a total of 28 on the provisional lowland acid grassland indicator list (**Table 8**).

Observations beyond the military railway corridor (Sanderson & Colebourn, 1996, Sanderson & Stanbury, 1996 and personal observations by N.A. Sanderson, EPR) suggest that U1c will readily form in disturbed, slightly nutrient-enriched, soils, eg road verges and formerly improved fields. However, if such grassland is not continually grazed by rabbits, it will be lost to ranker vegetation. A source pool for re-colonisation may be important as stands distant from existing stands, ie at least 400m away, were found to lack the more local species. Disturbed, unenriched soils under heath are more likely to favour re-colonisation straight back to heath without any acid grassland stage.

Other heathland areas

Beyond these areas the most significant areas of acid grassland among heathland are found in north east Hampshire and the fringe of the New Forest. In the former a large area of U1d type grassland has developed at Blackbush (SU 8059), in heathland disturbed by war time air-field development, while small areas of U1, U2 and U3 occur in other heaths in the area. The New Forest fringe has sizeable areas developing on old gravel workings to the in the Fawley area (SU4501), and smaller areas of U1 and U3 elsewhere. In all there is certainly over 100ha of acid grassland beyond the New Forest and Woolmer Heaths but much less than 500ha.

Coastal grazing marshes (Norton, 1996, Sanderson, 1995, 1996a & 1996b)

Several surveys of coastal grazing marshes along the Solent coast have recorded small areas of parched acid grassland. These are found on old shingle banks within enclosed marshes, the edge of river terraces and on the banks of old salt pans.

In the Keyhaven to Lymington Marshes (SZ3191) (Sanderson, 1996a), 5.5ha of U1f was recorded on banks and on an old shingle structure. On the latter, the U1f graded into Festuca-Armeria Maritime community (MC8) near the sea. The flora was rich with *Trifolium ornithopodioides, Vicia lathyroides, Sedum anglicum* and *Cladonia foliacea*, and has a total of 12 species on the provisional acid grassland indicator list (**Table 8**).

At the Lower Test Marshes (SZ3613) (Sanderson, 1996b), a small area (0.5ha) of U1f, rich in clovers, was recorded on the edge of a river terrace above the marshes. The flora included Trifolium glomeratum among 8 species on the provisional acid grassland indicator list (**Table 8**), of which 4 are acid grassland species listed in **Table 1**.

At Titchfield Haven a mixture of U1f and U1d was found in an old sand pit in a terrace edge above the marsh and on stabilised shingle grassland (Norton, 1996). These areas are spectacularly rich with the nationally rare *Lotus angustissimus* as well as *Trifolium scabrum, Trifolium striatum, Trifolium suffocatum, Trifolium ornithopodioides, Trifolium subterraneum* and *Moenchia erecta*. A total of 15 species are present on the provisional acid grassland indicator list, of which eight are species generally faithful to acid grassland (**Table 1**).

Other than these areas there is a tiny patch of U1 recorded at Farlington Marshes (Sanderson, 1995a), and the rich shingle structure at Browndown supports a mixture of U1f and heath (Sneddon & Randall, 1994). Extensive U1f, MC8 and probably U1a occurs at Gravelly Marsh, Beaulieu (Hampshire Flora Group field meeting). Other species-rich coastal sites lacking NVC surveys exist in the south east of the county (Brewis *et al* 1996), including large areas of U1 (probably over 50ha), some of which is U1a, on the south of Hayling Island, on the inland side of dune/shingle complexes. Here the U1 grades into MC8 and MC5 on shingle and to SD11 on dunes.

Bransbury Common (Sanderson, 1996c)

An unusual site from which acid grassland has been recorded is Bransbury Common (SU4141). This is a calcareous, peaty flood plain site, with extensive base-rich fen meadows and associated calcicolous grassland (CG2c) on mounds of chalky gravel. In one part of the common the chalky gravel is replaced by flint gravel and the CG2 chalk grassland is replaced by incongruous stands of parched acid grassland (U1d) covering 2ha. The species present include four species on the provisional indicator list: *Aira caryophyllea, Aira praecox, Aphanes inexspectata* and *Koeleria macrantha* but no species from **Table 1**.

Summary of consultations with Local Team Conservation Officers

A management plan for the acid grasslands of the New Forest is to be produced in the next few years and there is therefore a need for research and survey of some aspects of these grasslands. In particular, research into the effects of the late cutting of Bracken is needed. This practice has been revived, with the litter composted for use in horticulture. The cutting has been very successful in increasing the habitat quality of the herb-rich bracken stands for the rare plants present, and in increasing the grazing value of the Bracken stands by preventing the build up of litter. The shade of the Bracken canopy prevents the parching of the grass sward beneath and provides an important grass resource in the latter part of the summer when the U1 grasslands have become parched. There is, however, a worry that the annual cutting of the Bracken is too severe a regime for butterflies using the Bracken stands. There may also be practical advantages in cutting on a longer rotation to permit treatment of a larger area of Bracken. More information is required on the best cutting regimes to avoid damage to the invertebrate fauna of herb-rich Bracken, and in particular, surveys are planned to examine the butterfly fauna of herb-rich Bracken.

Based on information from the heathland inventory currently being compiled, it is clear that U1 dominates over U2 in north Hampshire and in the Weald. It is not considered that there is a problem with *Deschampsia flexuosa* substituting for *Calluna* in Hampshire and great progress is being made in restoring grazing to heathlands in the north of the county and in the Weald.

17.4 Summary of resource

Extent and composition

The acid grasslands of Hampshire are mainly found as parts of habitat mosaics in heathland and coastal habitats. In both, acid grassland makes a significant contribution to the biodiversity of the sites in which it is found. In the case of vascular plants, acid grasslands are much more important than Heather-dominated heath in contributing to the diversity of the heathlands. This is especially marked in the New Forest.

The composition of Hampshire's acid grasslands spans much of the range of acid grasslands in the lowlands. A south western type of mixture exists in the New Forest with U1f and U3 dominant, and a very eastern mixture of U1b dominant with U1a, U1c and *Carex arenaria* communities (SD10 & SD11) is present in Woolmer Forest. Whilst the New Forest contains the bulk of Hampshire's acid grasslands, floristically rich areas also occur on the coast and in the other heathland areas.

Conservation value

The New Forest is an area of major international importance for its heathland habitats. The acid grasslands form an integral part of the heathland habitats and are of exceptionally high interest in their own right.

The Weald heathlands are also of high importance, with acid grasslands making a significant contribution to this interest. The Lower Greensand heathlands of the western Weald, including those of Sussex and Surrey collectively, form an important transition between the heathlands of the south west and the east.

The coast contains small but floristically important areas of acid grassland, whilst the north east still has large areas of U1d type acid grassland associated with air fields. However, in general, the heathlands of this area are much more degraded when compared to those of the south.

17.5 Future requirements for survey and conservation

Survey

Detailed Phase 2 surveys of selected areas of acid grassland in the New Forest are required to establish a more detailed overview of the resource and to provide data for monitoring. The existing Phase 2 surveys of the Woolmer Forest acid grasslands are valuable for these reasons and similar surveys would be appropriate for at least some of the more significant areas of acid grassland elsewhere in the county.

Conservation

The problems of the New Forest are those of a functioning, multi-use, extensive pastoral system, differing to those of most other lowland heathlands where extensive pastoral systems have collapsed. They include:

- the continued survival of the commoners in changing economic and social circumstances
- coping with the sheer weight of visitor numbers
- counteracting past habitat fragmentation by habitat restoration
- the problems of stock and traffic accidents on unfenced roads.

Beyond the New Forest the problems of heathlands and acid grasslands are much more standard: severe habitat fragmentation and the lack of grazing. The Hampshire Heathland Project is beginning to counteract these factors and there are proposals for restoring entire heathland landscapes in the future, particularly in the north east Hampshire, where it is especially required. As far as acid grasslands are concerned, the Lower Greensand would be an obvious priority for restoration of acid grassland from cultivated land.

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Extract from Table 6 for Hampshire: occurrence of plant species generally faithful to lowland acid grassland

County: Hampshire					
Natural Areas:	77	70	66	78	75
Grasses					
Vulpia ciliata ambigua	1	1			1
Other Vascular Plants					
Chamaemelum nobile	1	1	1	0	1
Crassula tillaea	1	1	1		1
Erodium maritimum	1				0
Filago minima	1	1	1	1	1
Gladiolus illyricus	1				
Herniaria glabra		1			
Hypochaeris glabra	1	1	0		1
Lotus angustissimus	1				1
Lotus subbiflorus	1	0			1
Moenchia erecta	1	1	1		1
Ornithopus perpusillus	1	1	1	1	1
Potentilla argentea		1	1	1	0
Sagina subulata	1		0		1
Stellaria pallida	1	1	1	1	1
Teesdalia nudicaulis	1	1	1		1
Trifolium glomeratum	1	1			0
Trifolium ornithopodioides	1	1	1		1
Trifolium scabrum	1	1			1
Trifolium striatum	1	1	1	1	1
Trifolium subterraneum	1	1	1	0	1
Trifolium suffocatum					1
Vicia lathyroides	1	1			1
Viola lactea	1		1		
Total no. of species extant	**21**	**17**	**12**	**5**	**18**
Total no. of species extinct	**0**	**1**	**2**	**2**	**3**
Total no. of species recorded	**21**	**18**	**14**	**7**	**21**

77 = New Forest (excludes coastal records of *Trifolium suffocatum*)
70 = Wealden Greensand (Wealden heaths)
66 = London Basin
78 = Hampshire Downs
75 = South Coast Plain and Hampshire Lowlands

1 = Recent record
0 = Apparently extinct

Hampshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1987-92	Heath, Pasture woodland, Field	Excludes many heathland & coastal sites	49	29511.7	52.0	7.3		
Heathland Inventory		1982-94	Heath, Enclosure relic	Mainly in NA77, 66 & 70.	175	42420.0			7231.2	0.5
New Forest Survey Ha		1992	Heath, Pasture woodland	Estimated from Clarke & Westerhoff (1992)	1	19773.8	3299.36	c 2300.0	5848.0	
New Forest Classes		1992	As above	Estimated from Clarke & Westerhoff (1992)				E		
South Hants Heath		1996		Outside of New Forest open grazings				C		
Weald Heath		1996		N. Sanderson, EPR				B		
North Hants Heath		1996		N. Sanderson, EPR				C		
Coastal Grazing Marsh		1996	Coastal marshes	N. Sanderson, EPR				B		
Brandsbury Common	SU415420	1996	Flood plain	Survey of flood plain common (Sanderson,1996c)	1	69.8	64.6	2.0		
Estimates, classes		1996		N. Sanderson, EPR				E		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
New Forest ha	c1000		c30		c 600	c20	c350				c1100	c20										c 500
N. Forest Class	D		A		D	A	C				D	A										C
South Hants	B		A			A	B	A	A		B											
Weald Heath	B	A	A	A	A																	
North Hants	C				B	B	A	A	A		A											
Coastal Marsh	B	A			A		B															
Brandsbury	2.0				2.0																	
Estimates, class	E	A	B	A	D	A	D	B	B		E	A								A	A	C

Key

Column headings

GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland

H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates

A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha

F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

18. Hereford and Worcester

18.1 Physical

Geology

The Silurian and Precambrian outcrops of the Malvern area are a striking contrast to the very uniform Old Red Sandstone to the west. New Red Sandstone dominates in the east, with Barren Red Carboniferous rocks in the north east and a small area of Silurian uplands in the north west.

Soils

In the east, areas dominated by acid soils are confined to the Malverns and around Kidderminster. The former are dominated by brown podzolic soils and the latter by brown sands. In Hereford there are areas of brown podzolic soils on hills to the west such as Hergest Ridge (**Map 1c**).

18.2 Landscape history

19th Century

The 1830 1inch maps show that beyond the Malvern area there were only limited areas of common or rough grazing at this time.

Current landscapes and Natural Areas

The extensive common grazings of the Malvern area still exist, extending across the Malvern Hills and Teme Valley (NA52and the Severn and Avon Vales (NA56) Natural Areas. Small areas of heathland also survive in the north east about Kidderminster, in the Midlands Plateau Natural Area (NA43). Other Natural Areas either have limited potential for acid grassland or are predominantly upland.

18.3 Existing information

Flora

Two areas stand out on the coincidence maps (**Maps 2** to **4**), the Malvern Hills and the Kidderminster area. The latter extends into Staffordshire and Shropshire (NA43) and the acid grassland flora listed in the extract of **Table 6** below is not restricted to Hereford and Worcester. This flora is a remarkable outlier of the eastern English lowland acid grassland flora, with *Silene conica* and *Corynephorus canescens* recorded (the latter as an assumed introduction) along with typical species including: *Dianthus deltoides, Teesdalia nudicaulis, Moenchia erecta, Filago minima* and *Hypochaeris glabra.* The area also once supported *Erodium maritimum* but this appears to be extinct. The area includes 12 acid grassland species, listed in **Table 1**, two of them are apparently extinct.

The Malvern Hills flora is not as spectacular but includes *Trifolium ornithopodioides.* Davis (1994) also mentions *Potentilla neumanniana, Ornithopus perpusillus, Cerastium semidecandrum, Moenchia erecta* and *Trifolium striatium* from the Malvern Hills. The Malvern Hills Natural Area includes 10 species generally faithful to acid grassland, 2 of them are apparently extinct (see **Table 6** and relevant extract below).

Fauna

The Bracken stands of the Malvern Hills support populations of High Brown Fritillary (*Argynnis adippe*). Gibbons *et al* (1993) record that whilst Wheatear bred in the 1968-72 period in the Malvern Hills it was absent in the 1988-91 period (but they may now breed again). This would be consistent with the reduction of grazing pressure reported by Davies (1994) during this period. Stonechat and Whinchat still bred in the 1988-91 period.

Habitat surveys

The Grassland Inventory records acid grassland as present in the Midlands Plateau Natural Area (NA43) in fields in the Wyre Forest area and in commons and enclosure relics on the Bunter Sandstone heaths around Kidderminster.

The Heathland Inventory notes that heathlands occur on the Malvern Hills and the Kidderminster area. Nothing has been recorded in the Inventory the west of the county.

The Malvern Hills SSSI: feasibility study (Davies, 1994)

A report on the Malvern Hills SSSI vegetation and the feasibility of reintroducing grazing (Davies, 1994) includes data on the grassland. Quadrat data was collected and an NVC determination given using the MATCH 1.2 program. Unfortunately constancy data is not fully described so interpretation is not easy.

Bracken now dominates due to the decline in grazing since the 1960s. A total of 113.32ha of acid grasslands were recorded from the Malvern Hills. The most extensive grassland type is Deschampsia flexuosa grassland Festuca-Agrostis sub-community (U2a). This is confined to the highest ground above 250m.

On the lower ridges, on thin droughty soils, parched acid grassland (Festuca-Agrostis-Rumex grassland, U1) replaces the U2a and makes up the bulk of the remaining open grasslands. The parched acid grasslands are recorded as including the Typical sub-community (U1b) and the Galium-Potentilla sub-community (U1e). The former includes the acid grassland specialist lichen *Cladonia foliacea* at a constancy of IV.

On the hill slopes, Bracken dominates but Festuca-Agrostis-Galium grassland typical sub-community (U4a) is also recorded. However, there are problems with this determination; *Rumex acetosella* is recorded at constancy IV, *Aira praecox* at II, *Pilosella officinalis* at IV, *Galium verum* III, *Helianthemum nummularia* IV and *Thymus polytrichus* at IV. The presence of these species effectively rule out the classification of these grasslands as U4a. They appear to have closer relationships to both Festuca-Agrostis-Rumex grassland Anthoxanthum-Lotus sub-community (U1d) and Festuca-Agrostis-Thymus grassland (CG10). Little heath was surveyed but there are areas of H8/H12.

Summary of consultations with Local Team Conservation Officers & observations by EPR

The Malvern Hills and Castlemorton Commons complex contain the main area of acid grassland in Worcestershire. Steep rocky slopes on the Malvern Hills support parched acid grassland and may account for many of the lowland acid grassland species recorded. The Castlemorton Commons also include significant areas of acid grassland but the type is not known.

In the Kidderminster area, on the Bunter Sandstones, sites of interest include the exceptionally rich Hartlebury Common, where lichen-rich U1a forms a mosaic with heath in a floristically very rich site.

To the north of this is Hurcott Pasture SSSI, an enclosed pasture with a well-developed stand of U1f, which occurs here at the northern edge of its generally south western range. Selected data from Hurcott Pasture are presented in Volume I, Appendix 1, to illustrate this type of grassland.

The Coal Measure areas in the north support transitions between MG5c and U4, probably about 50+ha. The parched acid grasslands of the Kidderminster area also contain about 50+ha. There is probably between 500-1,000ha of acid grassland in total, but the data are insufficient to give accurate estimates of the relative proportions of U1 and U4 (the estimates given in the table below are conjectured by EPR).

In the west of Herefordshire there are no hard data. Acid grasslands are concentrated in the western fringe of the county in what are basically upland commons. These commons were estimated as having 2,000ha of all types of grassland in 1979. Much is probably invaded by Bracken. The rich, parched acid grassland, flora of south-facing rocky slopes in upland situations typical of Shropshire to the north are absent. Some commons support important populations of the High Brown Fritillary (*Argynnis adippe*).

18.4 Summary of resource

Extent and composition

There is little evidence for any significant area of strictly lowland acid grassland in Herefordshire west of the Malverns (perhaps less than 50 ha). In the west of the county the acid grassland appears to be of the difficult upland fringe type as well as of more typical upland character. The fringes seem to be upland in character and have few special lowland characteristics. However, additional data would enable the extent, character and significance of these upland fringe grasslands to be assessed. They are not included in the estimates in this report.

In Worcester and eastern Herefordshire there is a significant acid grassland resource in the Malvern Hills/Castlemorton Common area and in the Kidderminster area, with the latter the more floristically rich although it is much smaller. The Wyre Forest grasslands would probably be regarded as acid MG5 stands rather than acid grasslands in the strict sense. The extent of parched acid grassland across the eastern half of the county is not clear and EPR conjectured that it belongs at in the lower end of the 100-500ha class, and that very little true U4 exists.

Conservation value

The relic grasslands of the Kidderminster area are of the greatest floristic value as lowland acid grasslands, and are nationally significant as an outlier of species-rich eastern and southern grasslands.

The Malvern Hills and Castlemorton Commons are of major importance as an area of extensive pastoral habitats in which acid grassland is an important component habitat. The parched acid grasslands are probably the most interesting and have a lowland acid grassland flora of considerable importance as a grassland habitat. However, the whole mosaic is likely to be of national importance.

18.5 Future requirements for survey and conservation

Survey

Both counties are clearly deficient in survey data and both have surveys due to commence in 1997. It appears unlikely that the Herefordshire survey will consider lowland acid grassland as a high priority, although it may find significant upland fringe grasslands in the western part of the county.

In contrast the Worcestershire Wildlife Trusts grassland survey should be an opportunity to cover the important acid grasslands of the Kidderminster Heaths and the Local Team suggests that this area is a high priority for funding to complete the survey. To be of most use this survey should be carried out in spring/early summer and NVC communities mapped to sub-community level. There is also a need to cover the Bunter Sandstone heaths in neighbouring counties, in the same Natural Areas (NA43).

Conservation

The Kidderminster heaths are an exceptionally high national priority for the restoration of grazing and extension of grassland by habitat restoration. The Malvern Hills/Castlemorton Commons are under-grazed and lacking in vital infrastructure such as cattle grids. It is suggested that contact is made with managers of the New Forest, the most comparable area with similar problems, but an area where the level of grazing has been maintained. A preferred solution would integrate all the interconnecting commons in the area, avoiding sub-division. Successful establishment of extensive pastoralism on semi-natural vegetation in the lowlands is likely to be of high value in maintaining nature conservation interest.

18.6 References

DAVIES, S. 1994. *The Malvern Hills SSSI: feasibility study for the re-introduction of grazing.* London: University College London.

GIBBONS, D.W., RIED, J.B. & CHAPMAN R.A. 1993. *The new atlas of breeding birds in Britain and Ireland 1988-1991*. London: Poyser.

Extract from Table 6 for Hereford & Worcester: occurrence of plant species generally faithful to lowland acid grassland

County: Hereford & Worcester		
Natural Area:	**57**	**43**
Grasses		
Corynephorus canescens		1
Other Vascular Plants		
Chamaemelum nobile	0	0
Dianthus deltoides		1
Erodium maritimum	0	0
Filago minima	1	1
Hypochaeris glabra	1	1
Moenchia erecta	1	1
Ornithopus perpusillus	1	1
Potentilla argentea	1	1
Silene conica		1
Stellaria pallida		1
Teesdalia nudicaulis	1	1
Trifolium ornithopodioides	1	1
Trifolium striatum	1	1
Vicia lathyroides		1
Total no. of species extant	**8**	**12**
Total no. of species extinct	**2**	**2**
Total no. of species recorded	**10**	**14**

57 = Malvern Hills and Teme Valley
43 - Midlands Plateau (may include records from other counties)

1 = Recent record
0 = Apparently extinct

Hereford & Worcestershire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1986-92	Fields, Common, Heath	All in NA 43	11	427.8	52.5	3.8		
Heathland Inventory		1985-87	Common, Heath, Enclosure relic	NA 43 & 57. Area of heath not measured in NA57	14	1848			55.0	
Estimates, classes		1996		Peter Holmes EN & N. Sanderson EPR				D		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Worc. Estimate	C	A	+		+	+		B	B			B	+	+								+

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

19. Hertfordshire

19.1 Physical

Geology

Much of Hertfordshire lies on Chalk but parts of the Thames Basin Tertiary deposit is included to the south. To the east, the Chalk is covered by Boulder Clay whilst the rest lies under thick Clay-with-Flint caps. Extensive deposits of gravel occur in the river valleys.

Soils

Dry acid soils are nowhere dominant (**Map 1b**).

19.2 Landscape History

19th Century

In the early 18th century, commons may have covered over 10,000 ha but by the 19th Century only a scatter of small commons remained, apart from the Ashridge Commons. The remnant commons occured mainly on Clay with Flints deposits.

Current landscapes and Natural Areas

The county includes parts of the East Anglian Plain (NA50) and the East Anglian Chalk (NA51) Natural Areas, where there is little potential for extensive acid grassland. The rest of the county is split between the London Basin (NA66) and Chilterns (NA65). Some commons survive but are generally overgrown.

19.3 Existing information

Flora

The coincidence maps of the lowland acid grassland species listed in **Table 1** (**Maps 2** to **4**) show that there was a high concentration to the south, from Harpenden to Hertford. This flora has declined greatly this century. An extract from **Table 6** is given below.

Dony's Flora of Hertfordshire (Dony, 1967) indicates that the Clay-with-Flints and river gravels were as important as the Tertiary deposits for acid grassland. His habitat studies suggested that fragments of parched acid grassland (U1) were present in the 1960s, including U1d.

Habitat surveys

The Grassland Inventory records quite a large number of sites including acid grassland occurring on Tertiary deposits, Clay with Flints and on river gravel. Fewer heathland sites are recorded in the Heathland Inventory.

The maps in the NVC, Volume 3, show that U1b and U1e were sampled from the county.

Biological survey of common land: Hertfordshire (Francis et al, 1990)

This survey recorded 56ha of unimproved acid grassland, although this includes wet acid grassland (*Junco-Molinion,*) and 44ha of semi-improved acid grassland. The latter included some acid permanent pasture (MG6b). Interestingly, Francis *et al* (1990) point out that a Phase 1 survey of grassland in Hertfordshire by Hertfordshire County Council in 1988 recorded 480ha of acid grassland from common land.

The dry grassland is mostly parched acid grassland (U1) with some Deschampsia flexuosa Grassland (U2). Most of the commons seem to be very degraded.

Summary of consultations with Local Team Conservation Officers

Acid grassland is estimated as covering between 100-500ha. It is very patchy in its distribution and mainly found in degraded heathland sites. The East Anglian Plain has some scattered but locally important sites, eg Patmore Heath. The Chilterns historically had areas of importance for acid grassland and heath, eg in the St. Albans District, and gravel extraction sites could be the basis of recolonisation or restoration.

19.4 Summary of resource

Extent and composition

Hertfordshire's acid grassland resource is now mostly very degraded, consisting of overgrown or mown relics of once diverse heathlands.

Conservation value

The acid grassland resource of the county is now of limited value except in a county context.

19.5 Future requirements for survey and conservation

Survey

No national priorities for Phase 2 survey.

Conservation

The condition of the county's acid grassland could be improved by positive management and there are opportunities for re-creation, although at a national level other areas would have a higher priority.

19.6 References

DONY, J.G. 1967. *Flora of Hertfordshire.* Hitchin: Hitchin Museum.

FRANCIS, I.S., PENFORD, N., FINCH, M. & AITCHISON, J.W. 1990. *Biological survey of common land No 12: Hertfordshire.* Peterborough: English Nature.

Extract from Table 6 for Hertfordshire: occurrence of plant species generally faithful to lowland acid grassland

County: Hertfordshire	
Natural Area:	**All**
Chamaemelum nobile	0
Dianthus deltoides	1
Filago minima	1
Moenchia erecta	0
Ornithopus perpusillus	1
Potentilla argentea	1
Teesdalia nudicaulis	0
Trifolium ornithopodioides	0
Trifolium striatum	1
Trifolium subterraneum	0
Total no. of species extant	**5**
Total no. of species extinct	**5**
Total no. of species recorded	**10**

1 = Recent record
0 = Apparently extinct

Hertfordshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1980-94	Enc relic, Field, Common, Flood plain	In NA66 and on drift in NA 65, 50 & 51	38	1434.0	15.1	9.6		
Heathland Inventory		1987-94	Enc relic, Common	In NA66 and on drift in NA 65	23	1545.0			16.6	
Commons Survey		1990	Common	Includes wet & semi-improved grassland (MG6b)				115ha		
Estimates, classes		1996		Stephen Ayliffe, English Nature				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Commons	+							+														
Estimates, class	B		+		+	+		A														

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
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C = 100-500 ha
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E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

20. Humberside

20.1 Physical

Geology

The former county of Humberside lies on bedrocks ranging from New Red Sandstone to Upper Chalk but most are buried in recent sediments. The most significant sediments for the support of acid grasslands are periglacial, wind blown, sand deposits, known as Coversand.

Soils

The sandy drifts give rise to large areas of brown sands and podzolic soils to the south of the Humber, with smaller patches to the north (**Map 1e**).

20.2 Landscape history

19th Century

In Gibbons (1975) the extent and desolation of the Coversand areas in the 17th century are described, and active sand dunes recorded as present. On the 1820's 1 inch OS maps there were still extensive areas of heathland between Risby Warren and Manton Warren. North of the Humber a large area of heathland existed at South Cliffe Common.

Current landscapes and Natural Areas

Much of the heathland to the south of the Humber survived into the 1920's, but since then, quarrying, plantations and agriculture have destroyed huge areas. The Coversand is found in three Natural Areas; the North Lincolnshire Coversands and Clay Vales (NA34), Humberhead Levels (NA22) and The Vale of York and Mowbray (NA16)

20.3 Existing information

Flora

The coincidence maps (**Maps 2-4**) of species listed in **Table 1** pick out the importance of the Coversand as one of the last areas on the east coast, with the exception of Northumberland, where a rich lowland acid flora is found. The species recorded for the Natural Areas within Humberside and adjacent counties are listed in **Table 6** (relevant extract given below).

Fauna

Woodlark were been recorded as breeding by Gibbons *et al* (1993) in the Coversand area.

Habitat surveys

The Grassland and Heathland Inventories reflect the results of the surveys described below.

The English Nature Chalk grassland data set included records of MG5b/U4 transitions from Yorkshire Wolds in a mosaic with CG2 and CG4. About 50ha of this mosaic were recorded.

Wigginton (1990) carried out a detailed survey of the Humberside coversands grassland. This survey recorded a Breckland mixture of parched acid grasslands (U1) and Sand Sedge communities (SD10 & 11) and included lichen-rich stands (U1a & SD11), U1b and a little U1f.

Some ephemeral-rich U1c was recorded but the late summer sampling date makes the quadrat data difficult to interpret and few annual plants were recorded. The quadrats given for U4 appear to be either indeterminate rank grasslands or U1e. Patches of *Nardus* and *Juncus squarrosus* occur and were equated with U5 and U6 but were atypical. The survey indicates about 130ha of acid grassland survived in about 350ha of heathland but with many of the sites very small. Only one lowland acid grassland species from **Table 1** was recorded with 17 of the locally characteristic species (**Table 2**).

A visit to the area in May 1997 by EPR showed that the application of WES funds for cutting Bracken, combined with very high rabbit grazing had greatly improved the condition of some of the heath. Especially spectacular was the development of over 50ha of U1c in the largest site, Risby Warren, in response the rabbit grazing and Bracken mowing. Countryside Stewardship had also resulted in the creation of extensive areas of early succession U1c with mobile sand dunes developing. The nationally scarce species *Hypochaeris glabra* and *Vulpia ciliata ambigua* present within five years of abandonment of arable cropping. The spring ephemeral flora was found to be exceptionally rich indicating the importance of spring/early summer surveys. Selected data from Coversand acid grassland is presented in Appendix 1, Volume I, as examples of this type of grassland.

Summary of consultations with Local Team Conservation Officers

South of the Humber, all the major areas of heathlands are now within SSSIs. These contain acid grasslands as a mosaic with heath, Bracken, and birch woodland. There are also smaller areas of acid grassland on numerous non-statutory sites. The acid grasslands are of particular value as an invertebrate habitat within the heathland mosaic. All the main SSSIs, except Messingham Heath SSSI, are in the Coversand Heath and Peatland Wildlife Enhancement Scheme (WES). This has been very successful in stimulating positive management over the past five years. This principally involves scrub clearance, bracken control and the reintroduction of sheep grazing.

Arable production is often marginal in the Coversand area and rapid reversion to acidic communities can occur on land taken out of production. For this reason, the Countryside Stewardship Scheme has particularly targeted the Coversand and as shown by the examples at Manton Warren has been very successful (see Appendix 1, Volume I).

Woodlark has bred recently on the Coversand area and a male was seen by EPR during a visit in 1997, displaying over a mixture of very short rabbit grazed grass heath and arable reverting to U1.

Beyond the Coversand, small areas of acid grassland exist among birch/oak woodland on sand lenses, overlying peat deposits, in the Humberhead Levels.

North of the Humber the main areas are also on Coversand, are included within the WES. They are similar to those south of the river. The best and most extensive examples are within Allerthorpe Common and South Cliffe Common SSSI. Pockets of acid grassland do occur in the incised valleys of the Yorkshire Wolds but the total amount is likely to be less than 10 ha.

20.4 Summary of resource

Extent and composition

The area still contains significant areas of a very Breckland-like habitat with *Carex arenaria* communities as well as acid grassland. The North Lincolnshire Coversand and Clay Vales Natural Area is rich in scarce and local species, although the degree of habitat fragmentation is high.

Conservation value

The Coversand heathlands are clearly of at least national importance for their acid grassland habitat, the recent improvements in the condition of the habitat and the associated inland sand dune features may mean the site has international value.

20.5 Future requirements for survey and conservation

Survey

The vegetation is generally well surveyed although there may be a need to improve floristic data on some sites. The species lists of Wigginton (1990) are unlikely to be complete.

Conservation

This appears to be well in hand. The long term aim should be to reduce the degree of fragmentation and to restore as much as possible the old Coversand landscape, typified by extensive, treeless, heathland.

20.6 References

GIBBONS, D.W., RIED, J.B. & CHAPMAN R.A. 1993. *The new atlas of breeding birds in Britain and Ireland 1988-1991*. London: Poyser.

GIBBONS, E.L. 1975. *The flora of Lincolnshire.* Lincoln: Lincolnshire Naturalists' Union, Lincolnshire Natural History Brochure No. 6.

WIGGINTON, M.J. 1990. *Botanical survey and assessment of the Humberside coversands, 1988.* England Field Unit Project No. 88. Peterborough: Nature Conservancy Council.

Extract from Table 6 for Humberside: occurrence of plant species generally faithful to lowland acid grassland

County: **Humberside**			
Natural Areas:	34 + 33	22 (part)	16 + 18 + 22 (part)
Grasses			
Apera interrupta	1		
Festuca longifolia	1		
Other Vascular Plants			
Chamaemelum nobile			0
Crassula tillaea	1		
Dianthus deltoides			1
Filago minima	1	1	1
Hypochaeris glabra	1	1	0
Moenchia erecta	0	0	0
Ornithopus perpusillus	1		
Potentilla argentea	1	1	0
Stellaria pallida	1	1	1
Teesdalia nudicaulis	1	1	1
Trifolium scabrum			1
Trifolium striatum	1	0	1
Trifolium subterraneum	1		
Vicia lathyroides	1	1	1
Total no. of species extant	**12**	**6**	**7**
Total no. of species extinct	**1**	**2**	**4**
Total no. of species recorded	**13**	**8**	**11**

34 + 33 = North Lincolnshire Coversands and Clay Vales & Trent Valley and Rises
22 = Humberhead Levels (part)
16 + 18 +22 = The Vale of York and Mowbray, Vale of Pickering and Humberhead Levels (part)

1 = Recent record
0 = Apparently extinct
All the records for the Natural Areas may include species recorded beyond Humberside

Humberside acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1982-88	Enc relics, Heath, calc/drift	Enc relics, Heath in NA16, 34 & 22 + some in NA19	15	396.8	75.4	13.8		
Heathland inventory		1984-92	Enc relics, Heath	Enc relics, Heath in NA16, 34 & 22	21	2379.0			312.9	
Wigginton (1990)		1900	Enc relics, Heath	Phase 2 survey (Gr Area includes other habitats)	14	332.8	350.0	130.0		
EPR 1997		1997		Re-estimates from field visit				C		
Estimate, classes		1996		Fromm Wigginton (1990)				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Wigginton (1990)	95.0	23.6	34.6	5.4	4.2		0.1	8.0	7.8			8.0	1.2	5.8				4.3	3.6	1.3	1.2	
EPR, 1997				B																		
Estimates, class	C	A	A	B	A		A	A	A			A	A	A				A	A	A	A	

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

21. Isle of Wight

21.1 Physical

Geology

The Isle of Wight is renowned as a geological microcosm of south east England. The hills of the Island are composed of Chalk and form an east to west spine, and occur as a ridge along the south east coast. Below the Chalk, Lower Cretaceous sediments outcrop on the south of the east-west spine and include the Lower Greensand. To the north, mainly clay Tertiary sediments outcrop above the Chalk. Plateau gravels locally cap the Tertiary deposits and the tops of some of the Downs.

Soils

Brown earths and surface-water gleys dominate the Island soils off the chalk. No areas are recorded as being dominated by podzols or brown sands on the soil map (**Map 1b**). Brown sands are, however, a component part of the Fyfield soil association which is developed on the Lower Greensand in the south.

21.2 Landscape history

19th Century

On the 1810 1 inch OS map about half the original Parkhurst Forest is shown, and is the largest area of unenclosed heathland and pasture woodland on the Island. The rest had been enclosed a few years before as farmland, with the remainder soon to be converted to plantations. Over the rest of the north of the Island there were still many small commons. On the Lower Greensand there were a few medium sized commons including Bleak Down and Blackpan Common. The Downs were largely rough pasture, and rough pasture was present on coastal spits such as St Helen's Duver.

Current landscapes and Natural Areas

The Island's landscapes are as varied as its geology but much of its heathland and acid grasslands have been lost since the 19th century, with quarrying and rubbish tips now accounting for the once rich Bleak Down. Patches do remain, mainly in the south of the Island.

21.3 Existing information

Flora

The coincidence maps (**Maps 2** to **4**) of species listed in **Table 1** suggest a rich lowland acid grassland flora has been recorded from the Isle of Wight, but there have been recent losses. The Flora of the Isle of Wight (Bevis *et al*, 1978) confirms that, in spite of losses of several rich sites since the 19th century, there was still a rich acid grassland flora on the Island in the 1970s. Some species thought lost by Bevis et al (1978) such as *Filago minima* have been refound. A total of 18 acid grassland species from **Table 1** have been recorded of which 2 are apparently extinct (see extract of **Table 6** below). These include Wild Gladiolus, *Gladiolus illyricus,* which was recorded from Bracken in sandy commons in the Blackpan Common area. Bluebell-rich Bracken still exists here but *G. illyricus* has long been extinct. Lack of grazing probably led to habitat degradation and its loss. The most outstanding site described in the Flora is St Helen's Duver (SZ6389), a shingle spit. Its outstanding flora, includes all six clovers listed in Table 1, the grass *Vulpia ciliata ambigua* and an outlying locality for *Scilla autumnalis*. Other sites mentioned include Redcliff by Yaverland (SZ6185) with clover species and *Silene nutans*.

Habitat surveys

The Grassland Inventory notes acid grassland as having been found with calcicolous grassland on three western Downs in 1987 and in the coastal grazing marsh of Brading Marshes in 1984. The English Nature Chalk grassland data set includes a record of a 2.24ha transition between MG5b and U4 at Garlstone Down. Personal experience (Neil Sanderson, EPR), however, suggests that the pure acid grassland that does occur on small patches of drift on these Downs is in fact parched acid grassland (U1).

Two habitat surveys cover well developed acid grassland (Sanderson, 1991 & 1997a). The first, Brading Marshes (SZ6387), is a very unusual site; an embanked grazing marsh enclosed by a sea wall in 1875. Rather than the small stands of parched acid grassland on banks typical of Solent grazing marshes, about 18ha of former sand banks are occupied by acid grassland. This includes about 6ha of Deschampsia flexuosa grassland (U2a) and areas of parched acid grassland (Festuca-Agrostis-Rumex grassland typical sub-community and Anthoxanthum-Lotus sub-community, U1b & U1d). The most peculiar feature, however, is a large area of *Nardus* grassland associated with *Agrostis capillaris, Polytrichum juniperinum, Rumex acetosella* and *Festuca ovina* with the lichens *Cladonia portentosa, C. crispata, C. furcata, C. floerkeana* and *C. cervicornis* and little else. Other than *Nardus* and *Agrostis capillaris,* this community has nothing in common with Nardus-Galium saxatile grassland (U5) and is best regarded as a form of Festuca-Agrostis-Rumex grassland (U1b) with *Nardus*, rather than a transition to U5.

At Osborne House (SZ5195) (Sanderson, 1997a), the lawns in the landscape parkland have patches of parched acid grassland (U1). These are referable to the Hypochaeris sub-community (U1f) and contain species such as *Festuca filiformis* and *Dicranum scoparium,* which are unexpected in ornamental lawns. Few specialist acid grassland species are present except for a new record of *Moenchia erecta,* now a rare species on the Island.

The Sand Dune Vegetation Survey of Great Britain (Radley, 1994) recorded 5.54ha of parched acid grassland from St Helen's Duver. The quadrat data indicates that U1f is the main sub-community present. A transition to Festuca-Armeria Maritime grassland (MC8) is indicated locally. This finding is interesting as the Shingle Survey (Sneddon & Randall, 1994) also surveyed this site. They recorded the shingle communities SH33, SH43 and SH48. The first is considered as synonymous with Festuca-Armeria Maritime grassland (MC8) which is reasonable but the latter two are regarded as synonymous with Ammophila-Festuca Semi-fixed Dune community (SD7) (Sneddon & Randall, 1993). This community however, was not recorded from St Helen's Duver by Radley (1989). This confirms the impression that much parched acid grassland (U1) found on fixed shingle may have been mis-identified as sand dune communities by Sneddon & Randall (1993).

Summary of consultations with Local Team Conservation Officers

Abstraction of data from the recently completed SNCI survey (unpublished) has identified all known areas of acid grassland of conservation interest on the Island. Not all acid grasslands will have been included, as species poor acid grassland in grazed fields will be under- represented. A total of 128ha of acid grassland is known, of which 104ha are parched acid grasslands (U1), around 6ha of *Deschampsia flexuosa* grassland (U2a) in Brading Marshes and over 17ha of Bristle Bent *Agrostis curtisii* grassland (U3).

The sites include large areas of the Wydcombe Estate, an unintensively managed farm on the Lower Greensand hills north of Niton, St Catherine's Down (an Upper Greensand ridge) and Blackpan Common near Sandown, a heathland site. Coastal Greensand cliffs also bear related vegetation.

Rare species include *Filago minima* at St George's Down and Row Down. Radley (1989) also refound this species at St Helen's Duver. *Scleranthus annuus* occurs on Row Down, *Moenchia erecta* on Brightstone Down, *Orobanche purpurea*, *Trifolium glomeratum*, *Vicia lathyroides* and *Silene nutans* at Redcliff (U1f), *Chamaemelaum nobile* at St Helen's Common and Puckpool Point and *Vaccinium myrtillus* occurs as scattered plants in acid grassland on the north west slope of Head Down (this could be U4).

21.4 Summary of resource

Extent and composition

The Isle of Wight's acid grasslands are mainly confined to the south and are all fairly small, but can be components of larger habitat mosaics and coastal sites. Parched acid grassland, U1, predominates but U2 and U3 are present. The presence of U4 requires confirmation but it is likely to be rare. Some of the U1 stands are floristically rich.

Conservation value

St Helen's Duver is floristically of outstanding importance and is probably of national significance as an example of species-rich parched acid grassland in a stabilised dune system. Other sites are of considerable importance to the biodiversity of the Island.

21.5 Future requirements for survey and conservation

Survey

The best sites are known and there is no urgent need for a Phase 2 survey.

Conservation

St Helen's Duver is owned by the National Trust and is well protected. It is rabbit grazed and has been restored from being a golf course to a nature reserve, albeit with high levels of public pressure. Beyond this, the potential to reintroduce Wild Gladiolus G*ladiolus illyricus* could be considered, though restoring the derelict habitat at Blackpan would be required. The restoration of acid grassland and heath should also be encouraged on suitable soils elsewhere. Such a restoration is planned for the gravel workings at St George's Down.

21.6 References

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Extract from Table 6 for Isle of Wight: occurrence of plant species generally faithful to lowland acid grassland

County: Isle of Wight	
Natural Area:	**76**
Grasses	
Vulpia ciliata ambigua	1
Other Vascular Plants	
Chamaemelum nobile	1
Filago minima	1
Gladiolus illyricus	0
Hypochaeris glabra	1
Lotus angustissimus	0
Moenchia erecta	1
Ornithopus perpusillus	1
Sagina subulata	1
Stellaria pallida	1
Trifolium glomeratum	1
Trifolium ornithopodioides	1
Trifolium scabrum	1
Trifolium striatum	1
Trifolium subterraneum	1
Trifolium suffocatum	1
Vicia lathyroides	1
Viola lactea	1
Total no. of species extant	**16**
Total no. of species extinct	**2**
Total no. of species recorded	**18**

76 = Isle of Wight

1 = Recent record
0 = Apparently extinct

Isle of Wight acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1987-84	Coastal, Drift/calcicolous		4	322.0	30.5	NI		
Heatland Inventory		1984-89	Heath, Drift/calcicolous	Includes several apparently without AG	12	1386.0			26.3	
St Helen's Duver		1989	Coastal	Shingle/sand dune system (Radley, 1989)	1			5.5		
Brading Marshes		1991	Coastal	Coastal grazing marsh (Sanderson, 1991)	1			18.0		
Osborne House		1997	Park	Landscape park (Sanderson, 1997)	1			2.5		
SNCI Survey		1996	Above plus enclosure relic, Field	Colin Pope, Isle of Wight County Council	22			128.0		
Estimate, classes		1996		Colin Pope, Isle of Wight County Council				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heatland Inv.																						
St Helen's	5.5							5.5														
Brading	12.0		+		+			6.0	6.0													
Osborne House	2.5						2.5															
SNCI Survey	104.0							6.0	6.0		17.0											
Estimate, class	C		A		A		A	A	A		A											+

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

22. Kent

22.1 Physical

Geology

Kent occupies the north eastern side of the Wealden anticline. This produces a succession from Lower Cretaceous to Tertiary sediments north to south. Of these, the most significant deposits for acid grassland are the Lower Cretaceous Lower Greensands, especially the Folkestone Sands, nd the Tertiary Blackheath Pebble Beds. These are found to the south and north of the North Downs. Superficial deposits of Clay with Flints cover most of the dip slope of the Downs. Recent coastal deposits include substantial shingle areas.

Soils

No areas in Kent are recorded as being dominated by dry acid soils on the soil map (**Map 1b**).

22.2 Landscape history

19th Century

In the early 19th century Kent had no large areas of unenclosed land beyond Dungeness. Medium-sized and small commons and greens were scattered throughout the area north of the Downs, and on the Lower Greensand. On the latter there were some reasonably large areas to the west of the county, with much pastture woodland. Old parks were quite frequent. In contrast, woodland was abundant but heathland was rare in the High Weald.

Current landscapes and Natural Areas

The south of Kent is within the High Weald Natural Area (NA72). Here acid soils are frequent and woodland is more prominent than grassland. To the north of this, the clay-dominated Low Weald and Pevensey Natural Area (NA73) has a very low potential for acid grasslands. The extensive shingle beaches of Dungeness lie within the Romney Marshes Natural Area (NA 71)

The Lower Greensand in Kent is included within the Wealden Greensand Natural Area (NA70), although the landscape is different to that of the western Weald. Many of the once frequent small commons have been enclosed along the Greensand. It lacks the heathland dominated landscape of the western Wealden Greensands but smaller areas do occur. North of the Downs lies the North Kent Plain (NA68), where some heathland still remains.

22.3 Existing information

Flora

The coincidence maps of the lowland acid grassland species listed in **Table 1** (**Maps 2** to **4**) show that there were high concentrations north of the Downs, on the Lower Greensand, and especially on Dungeness. These areas, but especially the latter, are still very rich. The High Weald is recorded as rather species-poor on these maps.

The Atlas of the Flora of Kent (Philp 1982) demonstrated that common acid soil species such as *Galium saxatile* and *Rumex acetosella* show concentrations in the High Weald (NA72), on the shingle of the Romney Marshes (NA71) and in the west of the Wealden Greensand (NA70). A scatter of records are present elsewhere and include the North Downs, presumably on drift deposits, and on the Eocene sands to the north of the Downs.

Species generally faithful to acid grassland (**Table 1**) are much more local. The High Weald is quite poor in such species, although Wild Chamomile *Chamaemelum nobile* and *Viola lactea* are, or were, restricted to this area. *Chamaemelum nobile* is nearly extinct (Winship, 1993) whilst*Viola lactea* is extinct. Otherwise, only *Ornithopus perpusillus* and *Trifolium subterraneum* have been recorded. Much richer are Dungeness, the Greensand and the area north of the Chalk. Acid grassland species found in these areas are listed on **Table 6**, a relevant extract of which is given below.

The huge shingle beach of Dungeness is the richest area, with fourteen extant species including many clovers and specialists such as *Medicago minima*. As well as these, other notable species include *Silene nutans*, and the RDB species *Gnapholium luteoalbum*, which has recently been recorded (Dr F. Rose, pers. comm.). The latter species is not found on the shingle itself but on deposits of a silty sand generated by the gravel extraction industry. The RDB lichen, *Cladonia mitis* also occurs on Dungeness acid grasslands (Brian Banks, EN, pers. comm.).

The Greensand still has 10 species and the area north of the Downs, thirteen, although these are more dispersed than on Dungeness. Hothfield Common is picked out as the richest area on the Greensand with a rich clover flora including *Trifolium glomeratum* and *Trifolium ornithopodioides*. The rarest species recorded north of the Downs is *Lotus angustissimus*, which has two localities.

Habitat surveys

The Grassland Inventory records only four sites: Hatch Park (TR04), Knole Park (TQ55), Hothfield Common (TQ94) and Old Park (TR15). The first three occur on the Lower Greensand and the latter on Tertiary deposits.

Two reports describe shingle beaches in Kent which contain an acid grassland element. The shingle survey of Great Britain (Sneddon & Randall, 1994) describes vegetation which is doubtless synonymous with parched acid grassland (U1) at Walmer (TR3750), and notes the scarce *Galium parisiense* as occurring within this community. Dungeness has been covered by an informative report (Ferry *et al*, 1990) which includes synonymies with the NVC.

Dungeness: a vegetation survey (Ferry et al, 1990)

The outstanding feature of Dungeness is the extent of parched acid grassland on the established shingle. A total of about 380ha of parched acid grassland was recorded in spite of large scale losses in the past to quarrying and military activity. The grassland remaining included 221ha of lichen-rich parched acid grassland (Cornicularia aculeata-Cladonia arbuscula sub-community, U1a), the largest stand recorded in Britain and possibly larger than the entire area of this community in Breckland. An extract of the data on this community is presented in Volume I, Appendix 1, as an example of acid grassland on coastal shingle. As well as this type, less oligotrophic areas support communities assigned to the Anthoxanthum-Lotus sub-community (U1d) and the Hypochaeris sub-community (U1f). Only where the shingle is being eroded on the south east coast do maritime communities occur, with swards referable to Festuca-Armeria Maritime community (MC8) and the Armeria-Cerastium Therophyte communities (MC5). A total of 6 lowland acid grassland species (**Table 1**) were recorded in the quadrat data and a further 14 locally characteristic species (**Table 2**) were recorded giving a total of 20 provisional indicators (**Table 8**). The U1a is very rich in lichen species compared to stands in Suffolk (Smith 1996, Smith and James 1995).

Summary of consultations with Local Team Conservation Officers

A Phase 1 survey of Kent has produced totals of 419.6 unimproved acid grassland and 317.9ha of semi-improved acid grassland. The amounts exclude the shingle grassland of Dungeness described above. Nearly all is parched acid grassland (U1). Deschampsia flexuosa grassland (U2a) is confined to scraps in the Charts, and the area of moist acid grassland (U4) is very small.

Much of the acid grassland is found in three parkland sites: Knole Park, Hatch Park and Old Park. The first two are grazed by stock but Old Park is ungrazed, except by rabbits in some places. Francis Rose described Knoll Park as rather species poor, probably mostly U1e, but Old Park is better with *Potentilla argentea* and *Trifolium glomeratum* and probably contains U1b. Much of it now appears to be more like neutral grassland, probably because of repeated mowing and leaving of the cuttings on the ground, carried out to control gorse (Rob Cameron, English Nature, pers. comm.). Hatch Park is largely U1e but has richer areas of U1b and U1a in old sand pits. Selected data from Hatch Park is presented in Volume I, Appendix 1, to provide an example of parkland U1 grassland.

Hothfield Common is excellent and very species-rich. North of the Downs, a notable site is Dartford Heath which includes approximately 50ha of U1 with *Trifolium ornithopodioides*. Other sizeable patches include parched acid grassland on former sand dunes within Romney Marsh, and tens of hectares of surviving lichen-rich acid grassland (U1a) at Hythe Ranges.

Other species-rich areas include fragments on the sites of former small commons along the Greensand including Willesborough Lees. At Folkestone the old sea cliff at TR109352 has parched acid grassland (U1) with *Silene nutans* and *Trifolium glomeratum*. There are a lot of small fragments in fields including stands with mire and neutral grassland in the High Weald. To the west, the Charts are pasture woodlands, which would have supported much more acid grassland in the past.

One curious area is the Lympne escarpment. This is composed of mildly base-rich sandstone with some interesting grassland but with unclear affinities in the NVC. From discussions with Dr Rose it seems these grasslands may be a mixture of, or transitional to, both MG5b and U1d. However, a recent assessment by English Nature reports that there is a mixture of *Brachypodium pinnatum* dominated areas and semi-improved neutral grassland.

The fauna of Dungeness has well researched and the site has rich invertebrate communities (see Morris and Parsons (1992)). Beyond the surviving commons and Dungeness, most of the acid grassland is grazed but there is the threat of improvement to the fragments that exist in fields. On Dungeness, rabbit grazing has been sufficient to maintain the parched acid grassland on what is a very low productivity site.

22.4 Summary of resource

Extent and composition

Kent has a few extensive acid grasslands and many smaller fragments. Parched acid grassland is dominant, with all sub-communities except U1c present. The lichen-rich form (U1a) is especially extensive. Sites with rich lowland acid grassland floras exist on the Eocene sands north of the Downs, on the Lower Greensand and Dungeness. Acid grasslands in the High Weald are rather species-poor.

Conservation value

The acid grasslands of Dungeness are likely to be of exceptional international value in their own right, independent of the coastal morphological value of the shingle structure. The lichen flora is also of considerable nature conservation value. Beyond this, the best areas are present on the Greensand and to north of the Downs, and are likely to be of national importance for their floristic interest.

22.5 Future requirements for survey and conservation

Survey

Locally, it is considered that there is a need to survey the mixtures of acid grassland, mire and neutral grassland in small fields in the High Weald are these are a priority for survey due to their vulnerability to improvement.

EPR considers that whilst this may be a priority for the mire and neutral grassland communities, the poverty of acid grassland in the High Weald in a national context means that is a lower priority for acid grassland. Of much greater priority is the need to assess existing data on acid grassland, including floristic data, on the Lower Greensand and north of the Downs and to carry out Phase 2 survey sites where appropriate.

Conservation

The ungrazed areas on the Lower Greensand and north of the Downs are probably a priority for restoration management. Beyond this, both areas would certainly contain suitable areas for the creation of new acid grassland and heathland from farmland. Long term consideration should be given to restoring an extensive pastoral system to Dungeness.

22.6 References

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Extract from Table 6 for Kent: occurrence of plant species generally faithful to lowland acid grassland

County: Kent			
Natural Areas:	71	70	68
Grasses			
Vulpia ciliata ambigua	1	1	1
Other Vascular Plants			
Filago minima	1	1	1
Hypochaeris glabra	0		
Lotus angustissimus			1
Medicago minima	1		
Moenchia erecta	1	1	1
Ornithopus perpusillus	1	1	1
Potentilla argentea		1	1
Sagina subulata		0	
Silene conica	1		
Stellaria pallida	1	1	1
Teesdalia nudicaulis	1		
Trifolium glomeratum		1	1
Trifolium ornithopodioides	1	1	1
Trifolium scabrum	1		1
Trifolium striatum	1	1	1
Trifolium subterraneum	1	1	1
Trifolium suffocatum	1		
Vicia lathyroides	1		1
Total no. of species extant	**14**	**10**	**13**
Total no. of species extinct	**1**	**1**	**0**
Total no. of species recorded	**15**	**11**	**13**

71 = Romney Marshes (Dungeness)
70 = Wealden Greensand
68 = North Kent Plain

1 = Recent record
0 = Apparently extinct

Kent acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1985-91	Park, Heath	Mainly in Greensand NA	4	559.5	NI	NI		
Heathland Inventory		1986-91	Heath, enclosure relic	Mainly NA 72 & 70, some north of the N Downs	22	1825.0			64.6	
Dungeness Phase 2		1990	Shingle beach	Report on vegetation survey Ferry et al (1990)	1	1149.9	518.8	381.2		
Estimates, classes		1996		Richard Collingridge, English Nature				D		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Dungeness	381.2	220.9			54.5		33.0															
Estimates, class	D	C	B/D		B	B/D	A	A	A			A										

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

23. Lancashire

23.1 Physical

Geology

The east of the county lies on New Red Sandstone, with Carboniferous sediments to the west. Millstone Grit forms the uplands of the Pennines and the Forest of Bowland. Glacial drift, including gravels and windblown sand, cover a great deal of the lowlands.

Soils

Podzols are widespread in the south of the county with patches dominated by brown sands elsewhere (**Map 1e**).

23.2 Landscape history

19th Century

The 1840's 1 inch OS maps show extensive raised mires and dune grazings in the lowlands but only very small areas of common land.

Current landscapes and Natural Areas

Truly lowland conditions are confined to the Lancashire Plain and Valleys Natural Area (NA13). The Area is intensively farmed and unimproved grassland is rare.

23.3 Existing information

Flora

The coincidence maps (**Map 2-4**) of acid grassland species listed in **Table 1** show marked concentrations of records of acid grassland species on the south west coast. Here these are presumably associated sand dunes. The restriction of lowland acid grassland species to dunes appears to be a feature of the north and west of England.

Habitat surveys

The Grassland Inventory includes many upland fringe grasslands. The Heathland Inventory records only a tiny area of dry heath, reflecting the historic rarity of lowland heathland in the county. A Phase 1 survey has been completed for the county (Kirby & Harwood 1993) from which all records of acid grassland within the lowlands (below 160m) have been extracted. This indicates about 50ha of acid grassland, mostly in fields and occasionally as relics of enclosure. It appears to be frequently associated with neutral grasslands.

Moist acid grassland (U4) is probably the main grassland present but *Nardus* (U5) and *Deschampsia flexuosa* (U2) grasslands are also frequently recorded. Acid grassland is found in steep-sided valleys, which also often have characteristic neutral grassland, as at Syd Brook Valley (SD544140). A different type of grassland is found on the inland Shirdley wind blown sand deposits at Mere Brow (SD480178). This site has been quarried, but around the lakes there is a herb-rich acid grassland with *Carex arenaria, Festuca ovina, Aira praecox, Rumex acetosella, Erodium cicutarium* and *Lotus* *corniculatus*. This is clearly a stand of Festuca-Agrostis-Rumex grassland Anthoxanthum-Lotus sub-community (U1d), representing a combination of species more typical of the south east of the country.

The biological survey of common land (Crowther & Aitchison, 1993) covered mostly upland commons but three lowland commons are recorded, with 7.4ha of acid grassland belonging to the grassland communities U2, U4 and U5.

Summary of consultations with Local Team Conservation Officers

In Lancashire, English Nature use an elevation of 160m as the cut-off point for defining lowland grassland. This definition does not therefore consider the many 18th century or later enclosures of common moorland which occupy the margins of the upland areas of the Pennines and the Forest of Bowland. With one exception, areas of drained raised mire have also been excluded. Most, if not all, lowland acid grassland defined this way is confined to the Lancashire Plain and Valleys Natural Area (NA13).

For the most part, the 28 sites identified by the Phase 1 survey of the county (Kelly & Harwood 1993) occur in areas which are either located on the Shirdley wind blow sands of West Lancashire, the Sherwood Sandstones which outcrop on the coast at Heysham, the peaty soils of drained raised mires of Silverdale, the sand dunes of the Fylde Coast or the glacial deposits around Houghton in the Ribble Valley. The total recorded area is approximately 50ha but this figure includes some semi-improved grassland.

23.4 Summary of resource

Extent and composition

The site at Mere Brow indicates that parched acid grasslands (U1) do occur in the south west, and more would be expected on the inland side on the dune systems . The Sand Dune Vegetation Survey (Radley, 1994) did not record any acid grasslands form dune systems but this may be due to urban and golf course development. It is thought that there are likely to be some acid grasslands on areas such as Fleetwood Golf Course.

This sort of grassland, whether acid grassland or Carex arenaria-Cornicularia aculeata dune community (SD11) is likely to harbour the surviving predominantly southern acid grassland species. Much more of this type of habitat survives in Merseyside.

Inland, in unimproved grassland sites, acid grasslands mainly occur as mixtures of U4, U2 and U5 with southern acid grassland species lacking. They mostly occur as small stands in individual fields, often with other grassland types.

Conservation value

Any stands of parched acid grassland (U1), especially where associated with Sand Sedge *Carex arenaria*, have considerable intrinsic interest and are like to harbour a specialist flora and fauna. Beyond these sand grasslands the acid U4/U2/U5 grassland are probably best assessed by their contribution to the habitat mosaic in which they occur. In particular they could be regarded as a feature enhancing the interest of sites with neutral grassland.

23.5 Future requirements for survey and conservation

Survey

The small areas of lowland acid grassland in Lancashire mean that a Phase 2 survey would be relatively easy. This, however, should be regarded as part of a general lowland grassland survey rather than an acid grassland survey. Any survey should also ensure that any sandy grasslands not covered by coastal dune surveys are also surveyed.

Conservation

The grasslands away from the blown sand areas are probably only of priority where associated with neutral grassland. Relic grasslands on blown sand are of greater priority and the potential for creating new areas could be investigated.

23.6 References

CROWTHER, K.A. & AITCHISON, J.W. 1993b. *Biological survey of common land No 26: Lancashire.* Peterborough: English Nature.

KELLY, P.G. & HARWOOD, T.R. 1993. Wildlife habitats in Lancashire: report of the Phase 1 habitat survey of Lancashire 1988-1992. Preston: Lancashire County Council and English Nature.

RADLEY, G.P. 1994. *National sand dune vegetation survey of Great Britain: a national Inventory. Part 1: England.* Peterborough: Joint Nature Conservation Committee.

Lancashire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1986-93	Field, Enclosure relic	Mostly in upland fringes	42	520.0	85.9	NI		
Heathland Inventory		1985-92	Dune Heath, Enc. relic, Waste	Small areas, many in quarries or drained bogs	26	550.0			5.4	
Phase 1 survey		1990's	Field, Enclosure relic, Coastal, Mire	Phase 1 survey	28			50.0		
Common Land Survey		1993	Grass heath & Common	Few lowland commons	3	38.7		7.4		
Estimates, classes		1996		Jon Hickling, English Nature				B		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Phase 1 survey	A							A				A										
Common Land								+										+				
Estimates, class	A							A				A						A				

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

24. Leicestershire

24.1 Physical

Geology

The county is dominated by New Red Sandstone to the north west, with Jurassic Lias clays to the south east. Inliers of Carboniferous Coal Measures and Precambrian rocks outcrop in the far north west and Charnwood Forest respectively, giving rise to higher ground, reaching to just under 280m in Charnwood. Dolerite intrusions cut through the New Red sandstone and drift covers significant areas.

Soils

Ground water gleys dominate much of the county including Charwood Forest. Only on the Carboniferous inlier to the north west does the soil map record soil associations dominated by brown sands (**Map 1c**).

24.2 Landscape history

19th Century

On the 1820 and 1830 1 inch OS maps , little unenclosed land is indicated. Charnwood Forest is clearly an area of late enclosure.

Current landscapes and Natural Areas

The Trent Valley and Rises Natural Area (NA33) covers most of the county. Within this Natural Area, the heavily farmed land is occasionally diversified by small areas of limestone and acid soil associated with Dolerite and Carboniferous sandstone.

The distinctive uplands of Charnwood Forest are separated as a Natural Area (NA39). Here relic heathland is a notable feature. To the south east the West Anglian Plain Natural Area (NA52) has only a limited potential for acid grassland.

24.3 Existing information

Flora

The coincidence maps (**Maps 2** to **4**) of acid grassland species listed in **Table 1** have been recorded not only in Charnwood Forest, but also to the south of Leicestershire, in National Grid square SP59.

A provisional list of characteristic lowland acid grassland species for Natural Areas NA33 and NA39 is given in **Table 6** and the relevant data is extracted below. This table suggests a considerable number of extinctions in both areas. The only significant acid grassland species mentioned in the Natural Area profile for Charnwood Forest is Moonwort *Botrychium lunaria*. The lichen flora of the rock outcrops is noted for harbouring local upland species at the edge of their range.

Habitat surveys

The Grassland Inventory includes many small fields in Charnwood Forest which are recorded as containing acid grassland, but these may not include acid grassland as it is defined for this report.

Both the Grassland and the Heathland Inventories indicate the survival of heathland with acid grassland in parkland and some of the larger enclosure relics in Charnwood Forest. Beyond the Forest, a scatter of acid grasslands are apparent in fields, parkland and on a common.

Summary of consultations with Local Team Conservation Officers

Charnwood Forest heathlands are dominated by Bracken with about 100-200ha of U20, which is to be reduced and replaced with more desirable communities. Wetter areas are dominated by *Molinia*. The main dry acid grassland is Deschampsia flexuosa grassland (U2) which covers less than 100ha. Parched acid grassland (U1b) is associated with rock outcrops and covers less than 10ha. Moist acid grassland (U4) is also limited in extent to less than 10ha. Most acid grasslands are part of larger heathland habitat complexes. The northern lichen *Icmadophila ericetorum* has an outlying locality in U2 grassland in Charnwood Forest

Beyond Charnwood Forest acid grasslands are scattered, but include Croft Pasture, a stand of 2ha of U1b around a rock outcrop, with *Moenchia erecta* (within the rich National Grid square SP59), Burbage Common (SP40) with less than 10ha of U2 and possibly some U4b, Croxton Park (SK82) with about 6ha of U4b, Twenty Acre Piece (SK62) with 3ha and Hardbyhill Wood with 0.5ha of U1b. On the Coal Measures there are some sites with U4b/MG5c transitions (<4ha) including Dimminsdale (SK32).

Burbage Common is mown, but many sites are grazed by cattle and/or sheep and a number of Countryside Stewardship agreements have been reached in Charnwood Forest. The restoration of heathland in an old quarry at Buddon Wood (Charnwood Forest) is proving successful, with both heath and acid grassland appearing.

24.4 Summary of resource

Extent and composition

Acid grassland is rather fragmented and dispersed across the county. The rather less diverse *Deschampsia* grass heath is the most extensive type with smaller areas of more species-rich U1 and U4.

Conservation value

The interest of Charnwood Forest mainly resides in its mixture of upland and lowland features, rather than in the intrinsic interest of its acid grasslands. Beyond this area, the scattered acid grasslands are clearly of some importance at a county level, but they are of lower significance at a national level. The important lichen flora of Charnwood Forest is mainly found on rock outcrops, which are a distinctive feature of the Forest.

24.5 Future requirements for survey and conservation

Survey

No high priorities for survey

Conservation

Restoring the quality of the existing heathland habitats and their extension within Charnwood Forest is the most obvious priority.

Extract from Table 6 for Leicestershire: occurrence of plant species generally faithful to lowland acid grassland

County: Leicestershire		
Natural Areas:	**39**	**33**
Chamaemelum nobile	0	0
Dianthus deltoides		0
Filago minima	1	1
Hypochaeris glabra	0	
Moenchia erecta	1	1
Ornithopus perpusillus	1	1
Potentilla argentea	1	1
Stellaria pallida	0	0
Teesdalia nudicaulis	0	0
Trifolium scabrum		0
Trifolium striatum	1	1
Trifolium subterraneum	0	0
Total no. of species extant	**5**	**5**
Total no. of species extinct	**5**	**6**
Total no. of species recorded	**10**	**11**

39 = Charnwood Forest
33 = Trent Valley and Rises

1 = Recent record
0 = Apparently extinct

Leicestershire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1983-94	Fields, Park, Common	Mainly in Charnwood Forest (NA39)	24	229.9	31.7	21.5		
Heathland Inventory		1983-94	Park, Enclosure relic	Mainly in Charnwood Forest (NA39)	11	970.0			34.3	
Estimates, ha		1996		Ian Butterfield, EN				100+		
Estimates, classes				Ian Butterfield, EN				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Estimates, ha	<20		<20					c100	c100			<20		<20								
Estimates, class	A		A					C	C			A		A								

Key

Column headings

GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates

A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

25. Lincolnshire

25.1 Physical

Geology

Lincolnshire lies on sediments ranging from New Red Sandstone to Upper Chalk, although much is buried by more recent sediments. The most significant in terms of acid grasslands are periglacial wind blown sand deposits and lacustrine sands and gravels. The Spilsby Sandstone, which lies below the Chalk, outcrops in the southern Wolds, and produces some very acid soils.

Soils

The sandy drift deposits give rise to large areas of brown sands and podzolic soils to the south of the River Humber, with smaller patches to the north. In the south of the Wolds the Spilsby Sandstone gives rise to brown sands along valley sides (**Map 1e**).

25.2 Landscape history

19th Century

Gibbons (1975) describes a vast extent of rough grazing as existing until the 18th century on both acid and base-rich soils. Most of this was rapidly enclosed in the late 18th century and early 19th century, but sizeable areas, especially on the droughty sandy soils, survived locally and are shown on the 1820's 1 inch OS maps. The northern-most areas are now outside the modern county but there were a large areas in the Scotton Common area, the Holton Warren area south of Caistor, Linwood Warren by Market Rasen, south east of Woodhall Spa, and very small areas elsewhere.

Current landscapes and Natural Areas

The main Natural Area of significance for acid grassland is the North Lincolnshire Coversands and Vales Natural Area (NA34). There is a small tongue of sandy soils extending into the Trent Valley and Rises Natural Area (NA33), which was included in the old Coversands Natural Area (old NA 16, Map 14). There is a little acid grassland in the Lincolnshire and Rutland Limestone Natural Area (NA38). In the 20th century, agriculture and plantations have destroyed much of what existed in the 1820's.

25.3 Existing information

Flora

The coincidence maps (**Maps 2** to **4**) of acid grassland species listd in **Table 1** pick out the importance of the Coversand as one of the last areas where a rich lowland acid grassland flora is found in the north east of England, along with the Northumberland Whin Sill. To the south of the Coversand area, the Woodhall Spa and the Sleaford areas also stand out. There have, however, been serious declines. The species recorded for the North Lincolnshire Coversands and Clay Vales Natural Area (NA34)and from blown sand on the Lincolnshire and Rutland Limestone Natural Area (NA38) are listed in **Table 6** (extract given below).

The Flora of Lincolnshire (Gibbons, 1975) gives a description of the distribution of acid grassland and it floristics before 1975. The heathlands are described as being predominantly grass heath. In the modern county, relics are mentioned at Laughton and Scotton Commons (SK89) with *Teesdalia*, *Ornithopus, Hypochaeris glabra* and *Potentilla argentea*. In the Nettleton Moor area (TF09) acid grassland with *Filago minima* and *Aphanes inexspectata* survived.

Fragments existed in the Laughterton area (SK87), with *Carex arenaria*, while Woodhall Spa had *Deschampsia flexuosa* grass heath. To the south, sand over limestone at Ruaceby Warren included acid areas with calcicolous grasslands, and the flora included *Carex arenaria* and *Herniaria glabra*.

Habitat surveys

The Grassland and Heathland Inventories record a fairly similar distribution to that described by Gibbons (1975). There have been no systematic surveys of acid grasslands in Lincolnshire.

Summary of consultations with Local Team Conservation Officers

The Coversand and fen edge gravels support mixtures of parched acid grasslands (U1) *Deschampsia flexuosa* grass heath (U2) with Bracken and some heath. The SSSIs include Kirby Moor with 40ha of U2 and Bracken; Moor Farm with 26ha of U1, U2 and Bracken; Linwood Warren with 13ha of what was previously all dense U2, although sheep grazing has produced more open U1; Woodhall Spa Golf Course with about 5ha and Scotton Beck Fields with about 16ha of grazed U1, and Scottton Common with heath and about 5ha of U2. The latter site is being managed under WES. In total there is 105ha of acid grassland present in SSSIs, and outside SSSIs there is a total of approximately 100ha in scattered fragments.

More Coversand and gravels are found in the Trent Valley between Lincoln, Laughterton and Newark. This area contains mostly over-grown fragments of grassland in gravel pits, with approximately 80ha of acid grassland, whilst in Laughterton Forest acid grassland occurs on relic sand dunes. A mobile *Carex arenaria* dune associated with *Potentilla palustris* fen is known to have still survived in the recent past (Clive Chatters, pers. com. 1996).

To the south, blown sand occurs over limestone in the Ancaster area, including 5ha of acid grassland in a mosaic with calcicolous grassland. There may still be up to 50ha of other acid grasslands on the edge of arable fields in this area. The fauna of the Coversand heaths is thought to be of great value and there is an unconfirmed report of the occurrence of the Ladybird Spider (*Eresus cinnaberinus*). About 40ha of species-poor, secondary, parched acid grassland also exists in gravel pits in the Fens but is of limited interest.

Finally the acid soils over the Spilsby Sandstone support approximately 500ha of grassland of unknown type, associated with valleys in the southern Wolds, and along the western edge of the Wolds. It is not clear how much of this is acid grassland in the sense of the NVC. Species of interest such as *Saxifraga granulata* mentioned as occurring do not suggest acid grassland, but the only SSSI on the Spilsby Sandstone, Haiton Sheepwalk, does support Festuca-Agrostis-Rumex grassland Potentilla-Galium sub-community (U1f).

25.4 Summary of resource

Extent and composition

The grass heaths fall into the 100-500ha range in their extent and can be assumed to consist of a similar Breckland-type mix to that found in Humberside. These heathlands still have a well developed lowland acid grassland flora.

The Spilsby Sandstone grassland is something of an unknown quantity. The sandstone outcrops support a bryophyte flora of local interest including *Racomitrium* spp which are rare in the East of

England (Tim Smith, pers. com. 1996) but there is no reference to acid grassland in published sources. It is not included in the acid grassland statistics for the county.

Conservation value

The Coversand and gravel grass heath sites of the county are much fragmented, although they are nationally significant, as relics of a once extensive heathland ecosystem unique to eastern England. They should be considered together with relics in neighbouring counties. The value of the Spilsby Sandstone based on the current limited data suggests it may be of county significance.

25.5 Future requirements for survey and conservation

Survey

The English Nature Local Team considers that there is a need to survey the Spilsby Sandstone grasslands but EPR feels that a small trial survey would be appropriate in the first instance, to ascertain the likely importance of the grasslands at a county or higher level. The present level of detail on the Coversand vegetation is not high and a Phase 2 survey would be ideal for monitoring and assessment of the current resource, although few new sites are likely to be found.

Conservation

Much of what survives of the Coversand grass heath is protected and managed and the main requirement is to extend the habitat. Any opportunities for restoration of large blocks of habitat should be pursued with vigour.

25.6 References

GIBBONS, E.L. 1975. *The flora of Lincolnshire.* Lincoln: Lincolnshire Naturalists' Union, Lincolnshire Nature History Brochure No. 6.

Extract from Table 6 for Lincolnshire: occurrence of plant species generally faithful to lowland acid grassland

County: Lincolnshire			
Natural Areas:	**34 + 33**	**34**	**38**
Grasses			
Apera interrupta	1		
Festuca longifolia	1		
Other Vascular Plants			
Crassula tillaea	1		
Dianthus deltoides		0	
Filago minima	1	1	1
Herniaria glabra			1
Hypochaeris glabra	1	0	0
Moenchia erecta	0		
Ornithopus perpusillus	1	1	1
Potentilla argentea	1	1	1
Stellaria pallida	1		0
Teesdalia nudicaulis	1	1	
Trifolium ornithopodioides			0
Trifolium scabrum			1
Trifolium striatum	1	1	1
Trifolium subterraneum	1		
Vicia lathyroides	1	1	
Total no. of species extant	**12**	**6**	**6**
Total no. of species extinct	**1**	**2**	**3**
Total no. of species recorded	**13**	**8**	**9**

34 + 33 = Coversands part of NA34 plus part of NA33 (was in old NA 16). Includes records from other counties
34 = Lincolnshire Clay Vales part of NA34 (old NA21)
38 = Lincolnshire Limestone

1 = Recent record
0 = Apparently extinct

Lincolnshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1983-89	Enclosure relic, Field	Mainly in NA34 Fragments in NA38 & 35	12	228.6	NI	NI		
Heathland Inventory		1985-95	Enclosure relic	Mainly in NA34	13	573.0			84.7	0.1
Estimates, classes		1996		John Shackles, English Nature				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Estimates, class	C	+	+		+	+		B	+											+	+	

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

26. Merseyside

26.1 Physical

Geology

Merseyside is mostly on New Red Sandstone, with Coal Measures in the north. Glacial drift and, on the coast, blown sands are important recent deposits.

Soils

The remaining non-urban parts of the county include many areas dominated by podzols and brown sands (**Map 1e**).

26.2 Landscape history

19th Century

In the 1840's Liverpool was already a substantial urban development, but extensive warrens were recorded on the coast to the north west. A few commons existed on the Wirral.

Current landscapes and Natural Areas

The area is included within the Urban Mersey Basin Natural Area (NA26). This is dominated by urban development but significant sand dune systems survive on the Sefton coast.

26.3 Existing information

Flora

The coincidence maps (**Maps 2-4**) of lowland grassland species listed in **Table 1** show concentrations in the coastal dune areas and on the Wirral. These areas contained rich northern out-posts of the lowland acid grassland flora and still have some interest, although seven species have been lost from the Wirral. Provisional lists of lowland acid grassland species are given for both areas in **Table 6** (relevant extract given below).

Habitat surveys

The Heathland Inventory includes areas of dune heath on the coast, enclosure relics and the surviving Thurstone Common on the Wirral, and fragments on industrial wasteland elsewhere. The Grassland Inventory indicates that areas of acid grassland occur on the dune systems and on industrial wasteland.

The national sand dune survey (Radley, 1994) records 10.02ha of *Deschampsia* grass heath (U2a) from the Mersyside dunes. Other reports refer to moist acid grassland (U4a & U4b) (Edmondson & Gateley, 1989, Edmondson, Gateley & Nissenbaum, 1989a & 1989b). However, the presence of species such as *Ornithopus perpusillus*, *Rumex acetosella*, *Aira praecox*, *Polytrichum juniperinum*, *Erodium cicutarium*, *Cladonia* spp, *Aphanes inexspectata* and *Corynephorus canescens* suggest these are parched acid grasslands (U1) rather than moist acid grassland (U4). The quadrat data presented appears to be from either Festuca-Agrostis-Rumex grassland Typical sub-community (U1b) or indeterminate *Festuca-Agrostis* swards. There seems to be no evidence that U4 grasslands exist in this dune system. Target notes suggests that the Anthoxanthum-Lotus sub-community (U1d) also occurs.

Nardus grassland (U5) is also recorded. The 'U4 grasslands' appear to be more widespread than the U2 grasslands, and may extend to twice the area.

Summary of consultations with Local Team Conservation Officers and local experts

There is likely to be 100-500 ha of acid grassland in Merseyside, on dunes, soils over sandstone and a little on drained peat. U1 and U2 occur on the dunes while U4 is found on derelict land. Colonisation of derelict land usually proceeds towards acid grassland rather than neutral grassland because of the acidity of the substrates. County Parks, including Sefton Country Park, have managed areas of acid grassland. (P. Gateley, C. Bennett, pers. comms. 1998). Small areas of grassland (<50 ha) occur on heathlands and golf courses on the Wirral (Dr. H. Ash, pers. comm. 1998).

26.4 Summary of resource

Extent and composition

Acid grassland in the county includes interesting transitions from parched acid grassland (U1) to dune communities, along with areas of Deschampsia flexuosa grassland (U2) and Nardus-Galium grassland (U5), and some moist acid grassland (U4).

Conservation value

The important dunes of the Sefton coast appear to contain northerly examples of parched acid grassland, with a typical flora, among the general mosaic of dune habitats.

26.5 Future requirements for survey and conservation

Survey

No high survey priorities but it would be useful to clarify the character of the dune grasslands.

Conservation

The extensive dune ecosystem of the Sefton coast, in which the acid grasslands are a minor component, is a priority site for conservation action and much management work has already been carried out there.

26.6 References

EDMONDSON, S.E. & GATELEY, P.S. 1989. *National sand dune vegetation survey Sefton Coast, Division 5.* Peterborough: Nature Conservancy Council.

EDMONDSON, S.E., GATELEY, P.S. & NISSENBAUM, D.A. 1989a. *National sand dune vegetation survey Sefton Coast, Division 4.* Peterborough: Nature Conservancy Council.

EDMONDSON, S.E., GATELEY, P.S. & NISSENBAUM, D.A. 1989b. *National sand dune vegetation survey Sefton Coast, Division 8.* Peterborough: Nature Conservancy Council.

RADLEY, G.P. 1994. *National sand dune vegetation survey of Great Britain: a national Inventory. Part 1: England.* Peterborough: Joint Nature Conservation Committee.

Extract from Table 6 for Merseyside: occurrence of plant species generally faithful to lowland acid grassland

County: Merseyside		
Natural Areas:	**26a**	**26b**
Corynephorus canescens	1	
Other Vascular Plants		
Dianthus deltoides		0
Filago minima	1	1
Hypochaeris glabra	0	
Moenchia erecta	0	0
Ornithopus perpusillus	1	1
Sagina subulata		0
Stellaria pallida	1	1
Teesdalia nudicaulis	1	0
Trifolium ornithopodioides		1
Trifolium striatum	0	1
Trifolium subterraneum		0
Vicia lathyroides	1	0
Total no. of species extant	**6**	**5**
Total no. of species extinct	**3**	**6**
Total no. of species recorded	**9**	**11**

26a = The Sefton Coast)
26b = The Wirral) Urban Mersey Basin Natural Area

1 = Recent record
0 = Apparently extinct

Merseyside acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1983-94	Sand dunes, Waste	Mainly inland of dune systems & on industrial sites	28	368.4	3.0	3.0		
Estimates, classes		1998		C. Bennett, P. Gateley				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Estimates, class	A		A		A			A				A						A				

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

27. Norfolk

27.1 Physical

Geology

The solid geology of Norfolk consists of Pleistocene Crag deposits over Tertiary deposits to the east, Chalk under most of the west of the county and a band of Lower Cretaceous rock to the west of the Chalk, including Lower Greensand. Most of these deposits are, however, obscured by drift deposits of glacial or fluvial glacial origin, including wind blown sand in the Breckland area. Other areas of sand and gravel deposits occur, including areas of terminal moraine along the coast and north of Norwich. There are also acidic coastal deposits.

Soils

Much of Norfolk is dominated by brown earths but brown sands are locally dominant in Breckland. Less extensive areas dominated by brown sands, together with some podzolic soils, are found on the Lower Greensand, an area north of Norwich, and along the north coast (**Map 1d**). In Breckland, complex mixtures of acidic soils are characteristic, reflecting the depth of the sand deposits over the underlying Chalk. These mixtures can occur as small stripes and in polygonal patterns, which are the fossilised remains of periglacial processes. Blown sand and sand dunes have historically made an important contribution to the ecology of the area. Acidic drained peats in the Broads have resulted from oxidization of previously pyritic-rich peats.

27.2 Landscape history

19th Century

The 1820 and 1830 1 inch OS maps show extensive rabbit warrens and rough grazings in Breckland. Beyond this area straight roads and many names relating to heathland indicate extensive recent enclosure across the rest of Norfolk. However, large unenclosed areas still existed on the Greensand and a scatter of commons survived elsewhere, mostly on areas of acid soil.

In Breckland, large areas survived into the 20th century with the area of grass heath in 1900 nearly double that of 1824. It should be remembered that intermittent recolonisation of arable by grass heath has been much more of a integral feature of Breckland than other heathlands in the country. In the 1930's 34% of the then existing heath was 'new' heath. Since that time there have been large-scale losses to agriculture and forestry (Lambley, 1994c).

Current landscapes and Natural Areas

English Nature picks out the Breckland Natural Area (NA46) and divides the rest into the East Anglian Plain (NA50) and the Broads (NA48), where there are some areas of brown sand, North Norfolk (NA47) which includes the Lower Greensand and areas of glacial sands and gravels, and the fringe of the Fens (NA 37).

27.3 Existing information

Flora

The coincidence maps (**Maps 2-4**) of lowland acid grassland species listed in **Table 1** show very high concentrations in Breckland, the Greensand heaths, the north coast and areas to the north and south of

Norwich. A decline is evident from inspection of the recent records throughout the county. In some inland areas, the losses have been very severe.

The flora of Breckland was covered by Trist (1979) and the flora of the whole of Norfolk by Petch & Swann (1968). The flora was analysed according to the following units, and species from **Table 1** were listed in **Table 6** in these units (extract below).

- Breckland Natural Area (NA46). The whole of the Natural Area, including Suffolk, was used, with no distinction between the two counties.
- North Norfolk and areas of NA50 to the south of Norwich.
- The river corridor along the River Waveney in both Suffolk and Norfolk in the East Anglian Plain (NA50) and the Broads (NA48) Natural Areas.

Breckland (all of NA46) is famed for its exceptionally rich grass heath flora, including species characteristic of dry acidic and base-rich soils, as well as sand dunes. It is the richest area in Britain for lowland acid grassland species with 24 species of the 33 species in **Table 1** extant and two apparently extinct. Many other species are present and include large populations of *Carex arenaria*, rare species such as *Silene otites* and many more widespread species. Trist (1979) and data on lower plant distibutions indicate that about 64 species listed on both **Tables 2** and **3** occur in Breckland in general, probably the highest total in Britain. *Holosteum umbellatum* has long been extinct and many surviving species are in a precarious situation, eg *Scleranthus perennis prostratus*. There are rich *Cladonia* communities in the acid grasslands but the lichen flora of the calcicolous grass heaths are much richer in rare lichen species. The bryophyte flora of the acid grasslands is not very distinctive and the fungi flora is unknown (Lambley, 1994a).

Along with the terraces along the Waveney described in the Suffolk section below, rich floras have been recorded from all the acid soil areas in Norfolk. However, extinctions have been widespread, and squares such as TG20 appear to have lost nearly all their species. Within Breckland, concentrations of species characteristic of disturbed acid sandy soils (**Maps 8-10**) still survive but these species are now rare beyond this area.

Fauna

Breckland harbours an important bird fauna including 10% of British Nightjars, 30% of British Woodlarks and over 50% of British Stone Curlews. It is one of the few areas where grass heaths are still sufficiently extensive to support Stone Curlew and although this species is increasingly using arable fields in which to nest, positive management of grass heath is resulting in a gradual return to this habitat.

Other species such as Woodlark and Nightjar depend more on the ephemeral appearance of acid grassland habitat types within clear felled conifer plantations rather than on grass heath, from which they are nearly extinct, although Woodlark has recently expanded back on to the grass heaths.

Wheatear is increasingly scarce, whilst Stonechat and Whinchat numbers are extremely low. Ring Plover, abundant in rabbit warrens in the 19th century, is now confined to arable fields and gravel pits. Montagu and Hen Harriers were lost by the middle of this century. However, a positive feature is the colonisation of grass heaths by Curlew, which utilise longer grass than Stone Curlew and other species (Gibbons *et al*, 1993 & Dolman, 1994).

The long term conservation of most species is thought to require the restoration of heavier grazing and greater physical disturbance. It is worth noting that many of these species (Woodlark, Nightjar, Ring

Plover, Wheatear, Stonechat and Whinchat) currently have larger populations on acid grasslands in the New Forest than they do in Breckland (see Hampshire section).

The importance and status of the invertebrates of Breckland is summarised in Ecological Change in Breckland (Hagget, 1994, Duffey, 1994 & Lambley, 1994b). Numerous RDB (160) and Notable (154) species are recorded from Breckland habitats, including grass heaths, fen, pingo pools and ruderal communities. The grass heath represents an important habitat with 34.2% of the RDB species recorded from it.

Interestingly the taller Heather stands which have appeared since myxomatosis reduced rabbit populations have no particular spiders of interest. This is in contrast to the rich spider fauna of the grass heaths. For groups which there is sufficient data, such as the moths and butterflies, there is firm evidence to indicate the decline and extinction of many species of disturbed grass heath or early succession communities.

Habitat surveys

The Grassland Inventory records large areas of acid grassland and calcicolous and acid grassland mosaics in Breckland and many small to medium patches elsewhere, mostly in North Norfolk, but with some also occurring in the East Anglian Plain and the border of the Broads. The Heathland Inventory indicates relatively large areas of heath in Breckland, on the Greensand, the area north of Norwich and on the north coast, as well as small fragments in other areas. The majority of the sites recorded on both Inventories are either commons or the relics of large scale enclosure of commons, warrens or rough grazings.

Norfolk grassland survey (Roberts & Smyth, 1990)

The Norfolk grassland survey was a systematic survey of non-SSSI, unimproved grasslands, in the county. It covered mainly neutral grasslands but sites with acid grasslands were also surveyed. Seventeen of these had a total of 61.22ha of parched acid grassland (U1) and two totalled 4ha of *Deschampsia flexuosa* grassheath (U2); the U1 sub-communities were not identified and the floristics were not discussed. An approximation of the areas of acid grasslands was given for the SSSIs, with 792.9ha of U1, 333.4ha of U2 in west Norfolk and 43.8ha of U2 for east Norfolk.

The Stanford Training area in Breckland was described as accounting for nearly 690ha of the U1, and in east Norfolk, Buxton Heath held 20.1ha of the U1 community. Bridgham and Brettenham Heaths in Breckland supported 312.2ha of U2. Inland, *Carex arenaria* communities (SD10 & 11?) were recorded as covering 100.6ha, of which 91.9ha occurred in the Stanford Training area.

Other than the above survey, the national sand dune vegetation survey recorded 7.3ha of U2 from Winterton to Horsey Dunes (Radley, 1994) and Norfolk was given as an area of important coastal stands of Carex arenaria-Cornicularia dune (SD11), the dune equivalent of lichen-rich parched acid grassland (U1a).

As far as can be judged from the national shingle survey, most of the stable shingle grassland in Norfolk is referable to MC5. However, at Snettisham Spit, parched acid grassland is clearly widespread, and to a greater extent than is indicated by the NVC synonymies of the survey (Sneddon & Randall, 1994).

Summary of consultations with Local Team Conservation Officers and personal observations

The extent of acid grassland in Norfolk is estimated as between 1,000-5,000 hectares. As well as the 1235.0ha identified in Roberts & Smyth (1990) there is probably about 50ha in Thetford forest and possibly up to 500ha in MOD land outside of SSSIs. Up to 200-300ha has also been reported in the Broadlands area.

Parched acid grassland (U1) is the dominant type present but there have been no surveys to identify sub-communities. The largest area by far is in the Breckland with patches in north Norfolk and limited areas elsewhere. Breckland is notable for its small scale mosaics of acid grassland with calcicolous grassland and sand dune communities. Chalk grassland surveys indicate that the Festuca-Agrostis-Rumex grassland Erodium-Teesdalia sub-community (U1c) may still survive in the Stanford Training Area.

The mix of communities in the Norfolk Breckland likely to be similar to that of Suffolk with Deschampsia flexuosa grassland (U2a) largely an artefact of neglect and the decline of rabbit grazing; grazing seems to convert it to Festuca-Agrostis-Rumex grassland Galium-Potentilla sub-community (U1e).

In the Greensand area little appears to survive, but EPR is aware of an area where grazing has been restored under Countryside Stewardship to the east of Roydon Common, where an interesting grassland mosaic occurs. Rich *Junco-Molinion* Communities (M23) on wet ground dominate but drier sandy mounds support a zone of *Nardo-Galion* vegetation dominated by *Nardus* . These represent the only few good examples of *Nardus-Galium Grassland* (U5) seen by the author in southern England. The drier parts of the mounds were dominated by *Thero-Airion* parched acid grassland (U1e).

The ecological condition of Breckland grass heaths is recovering under the ESA scheme, with sheep grazing occurring on most sites. Only two SSSIs are ungrazed whilst one is mown. Heathland restoration is under way in Breckland, the Greensand area and north Norfolk.

The Natural Area profile for the Broads Natural Area describes acid grassland (U1) of high botanical interest as present in the Broads in the Upper Thurne area, particularly around the Calthorpe Broad (Holve, 1996). There is also mention of valley side heathlands which must have once had U1 grasslands, but which are now largely lost, although restoration is proposed.

27.4 Summary of Resource

Extent and composition

The acid grassland resource is concentrated in Breckland but with floristically significant patches elsewhere. The composition has not been studied recently in terms of the NVC, but overall is similar to that of Suffolk, with the exception of the U1c that may have survived in the Stanford Training Area.

Breckland has a rich invertebrate fauna and is, with the New Forest, the only area with a surviving lowland acid grassland bird fauna of significance.

Conservation value

Breckland is the premier area for lowland acid grassland in England, and the heathland habitat mosaic of which it is part is clearly of international importance. Its condition has, however, given serious cause for concern and many of the distinctive species are severely reduced (Lambley, 1994c). Lack of heavy grazing by both stock and rabbits is a major cause of this decline, but the legacy of past fragmentation is probably also significant. The fact that with the exception of Stone Curlew, the acid grassland bird fauna is faring much better in the New Forest than in Breckland may be related to these factors. The areas in the county beyond Breckland are still important but not to the same level as Breckland itself.

27.5 Future requirements for survey and conservation

Survey

There is an urgent need for detailed Phase 2 surveys of remaining unsurveyed acid grassland areas in Norfolk. These surveys are valuable for monitoring purposes as well as to establish the composition of the resource, and would complement the Phase 2 surveys of Suffolk that have been carried out for these purposes.

Conservation

The restoration work that is possible under the ESA and Countryside Stewardship schemes needs to be carried out in both the Breckland part of Norfolk and the rest of the county. Green (1995) has produced a report for EN which sets out a heathland re-creation plan for Breckland. The long term future of the habitats and species of Breckland probably depends on a substantial reduction in the fragmentation of grass heaths through the reversion of arable and forestry land back to heathland. The acidic grassland areas in the Broads ESA need to be recognised within the objectives of restoration schemes.

27.6 References

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Extract from Table 6 for Norfolk: occurrence of plant species generally faithful to lowland acid grassland

County: East Anglia (Norfolk)			
Natural Areas:	46	47/50	48/50
Grasses			
Apera interrupta	1	1	0
Corynephorus canescens	1		0
Festuca longifolia	1		
Vulpia ciliata ambigua	1	1	1
Other Vascular Plants			
Chamaemelum nobile	0	0	0
Crassula tillaea	1	1	1
Dianthus deltoides	1	0	
Filago minima	1	1	1
Herniaria glabra	1	0	
Hypochaeris glabra	1	1	1
Medicago minima	1	1	0
Moenchia erecta	0	0	1
Ornithopus perpusillus	1	1	1
Potentilla argentea	1	1	1
Sagina subulata		0	
Scleranthus perennis	1	0	
Silene conica	1	1	1
Stellaria pallida	1	1	1
Teesdalia nudicaulis	1	1	1
Thymus serpyllum	1		
Trifolium glomeratum	1	0	1
Trifolium ornithopodioides			1
Trifolium scabrum	1	1	1
Trifolium striatum	1	1	1
Trifolium subterraneum	1	1	
Trifolium suffocatum	1		1
Veronica verna	1		
Vicia lathyroides	1	1	1
Total no. of species extant	**24**	**15**	**16**
Total no. of species extinct	**2**	**7**	**4**
Total no. of species recorded	**26**	**22**	**20**

46 = Breckland (includes Suffolk)
47/50 = North Norfolk
48/50 = The Broads and East Anglia Plain - River Waveney area (includes Suffolk)

1 = Recent record
0 = Apparently extinct

Norfolk acid grassland surveys

Survey	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1984-92	Grass heath, Heath, Enc. relic, Field	Large areas in NA46+many smaller areas in NA47	37	6424.3	605.7	68.8		
Heathland Inventory		1982-93	Grass heath, Heath, Enc. relic	In the 4 main areas of brown sands/podzols	70	8820.0			505.4	33.3
Grassland Survey		1990		Includes estimates of area in SSSIs+sites surveyed				1235.0		
Estimates, classes		1996		Claire Warnsbury, English Nature				E		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Grassl'd Survey	897.6							337.4												100.6		
Estimates, class	E	+	+	+	+	+		C	C									A		B	A	

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

28. Northamptonshire

28.1 Physical

Geology

Northamptonshire extends entirely over Lower and Middle Jurassic rocks from the Lower Lias to the Oxford Clay. Most of the rocks are clays and limestones but the Northampton Sand Formation, which includes ironstone and sandy limestone also occurs. Locally, glacial and river sands and gravels also exist.

Soils

None of the areas of acid soils are large enough to be recorded by the soil map, but the Northampton Sand Formation gives rise to localised brown sands (Gent & Wilson, 1995).

28.2 Landscape history

19th Century

The 1830 1 inch OS map shows few unenclosed areas with Harlestone and Dallington Heaths already planted with trees.

Current landscapes and Natural Areas

Among the Natural Areas that make up the county, the Midlands Clay Pastures (No. 44) has unimproved acid grassland, which occurs in individual fields, within golf courses and in some areas of coniferised heathland.

28.3 Existing information

Flora

The coincidence maps (**Maps 2-4**) of lowland acid grassland species listed in **Table 1** show that a slight concentration existed to the south west of Northampton, mainly on the Northampton Sand Formation. The distribution of *Deschampsia flexuosa* reflects this (Gent & Wilson, 1995). The recent flora of Northamptonshire (Gent & Wilson, 1995) provides a detailed account; a total of eight acid grassland species have been recorded from the area but five are now apparently extinct. The extinct species include an old record of the now threatened Red Data Book species *Scleranthus perennis.* The best site for this species was Harlestone Firs (SP714640), once part of Harlestone and Dallington Heaths, but long enclosed and planted with conifers. The rides still have rare *Ornithopus perpusillus*, *Trifolium striatum* and *Spergularia rubra* but *Moenchia erecta* is apparently extinct. Billings Lings (SP800635) was also once the home of many sand-loving plants but is now a conifer plantation.

Habitat surveys

The Grassland Inventory records 12 sites with acid grassland, most within the south-western part of the county. The largest site recorded is the Harlestone Golf Course but the area of grassland here is not given. The Heathland Inventory only records the remains of Harlestone Heath.

Acid grassland at Coombe Hollow (SP679838) is close to Festuca-Agrostis-Galium grassland Holcus-Trifolium sub-community (U4b) but lacks *Festuca ovina* and has much *Trisetum flavescens* while individual quadrats have strong tendencies to MG5c and U1c (Max Coleman, pers. comm. 1996). Significantly the site is on an acid clay soil derived from Middle Lias Clay rather than being on a sandy soil.

Summary of consultations with Local Team Conservation Officers

There are a total of 8ha of acid grassland in SSSIs. County Wildlife Sites known to include areas of acid grassland cover a total area of 54.6ha but the area of acid grassland within them is smaller than this total. NVC data does not exist for most sites but parched acid grassland (U1) has been identified from High Wood and Meadow and moist acid grassland (U4) from Coombe Hill Hollow. It is thought that U1 will dominate on most sites which are on the Northampton Sand Formation, and U4 may be confined to one site on the Lias. Problems have been experienced in finding a grazier for High Wood and Meadow SSSI.

Outside the SSSIs, golf courses are of major importance for supporting acid grassland, at least in terms of area. Recent conifer felling at Harlestone Firs has resulted in the reappearance of acid grassland and heath species, most notably *Ulex minor*, not recorded in the county for over 100 years. The future of the cleared areas is not, however, secure.

28.4 Summary of resource

Extent and composition

Northamptonshire has very little surviving acid grassland and has suffered a high level of extinctions of characteristic acid grassland species. U1 probably is the most extensive type and there is a small area of U4.

Conservation value

The surviving U1 and U4 grasslands are probably critical to the biodiversity of the county. The occurrence of a small area of U4 on acid clay soil is a curiosity of some intrinsic interest.

28.5 Future requirements for survey and conservation

Survey

Further Phase 2 surveys would be useful but are not a high national priority.

Conservation

Restoration of a large area of heathland at Harlestone Heath would be the most efficient method of conserving species-rich acid grassland.

28.6 References

GENT, G. & WILSON R. 1995. *The flora of Northamptonshire and the Soke of Peterborough.* Rothwell: Kettering & District Natural History Society & Northamptonshire Flora Group.

Extract from Table 6 for Northamptonshire: occurrence of plant species generally faithful to lowland acid grassland

County: Northamptonshire	
Natural Areas:	All
Filago minima	0
Hypochaeris glabra	0
Moenchia erecta	0
Ornithopus perpusillus	1
Scleranthus perennis	0
Stellaria pallida	1
Trifolium striatum	1
Total no. of species extant	3
Total no. of species extinct	4
Total no. of species recorded	7

1 = Recent record
0 = Apparently extinct

Northamptonshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1980-93	Field, Waste, Enclosure relic	Mostly near and south west of Northampton	12	323.8	149.3	50.3		
Heathland Inventory		1992-93	Enclosure relic	Mainly the remains of Harlestone Heath	3	3.5			1.0	
Coombe Hollow	SP679838	1979-96	Field	Note by Max Coleman, EN. Field with U4b	1	4.4		3.0		
Estimates, classes		1996		Max Coleman English Nature				A		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Coombe Hollow												3.0		3.0								
Estimates, class	A							A	A			A		A								

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

29. North East England (Cleveland, Durham, Northumberland, Tyne & Wear)

29.1 Physical

Geology

The south east of the area has Jurassic, Triassic and Permian rocks, including Magnesian Limestone, with Coal Measures dominating the central part of the east coast. The rest of the area lies largely on older Carboniferous rocks including limestones and sandstones. A significant feature in the north and west of the area is the Whin Sill which produce distinctive craggy outcrops. Glacial till overlies much of the area.

Soils

The lowlands of the north east are dominated by surface water gleys, with only a few patches dominated by podzols and brown sands (**Map 1f**). The largest areas of the Whin Sill, which outcrops along Hadrian's Wall, are dominated by humic rankers.

29.2 Landscape history

19th Century

The 1860's 1 inch OS maps show a thoroughly enclosed lowland landscape with little heathland.

Current landscapes and Natural Areas

The north east of England is dominated by two predominantly upland Natural Areas, the Border Uplands Natural Area (NA2) and the North Pennines Natural Area (NA4). A small part of the upland North York Moors and Hills Natural Area (NA17) is also included.

The lowlands are divided into four Natural Areas; the North Northumberland Coastal Plain Natural Area (NA1) which covers the fairly narrow coastal plain to the east of NA2, the large Northumbria Coal Measures Natural Area (NA5), the Durham Magnesium Limestone Natural Area (NA6) and the Tees Lowlands Natural Area (NA7).

29.3 Existing information

Flora

Large areas of the north east are devoid of the lowland acid grassland species listed in **Table 1**, but there are local concentrations of these species, especially in the Border Uplands and Northumberland Coastal Plain Natural Areas (**Map 2** to **4**). These concentrations at least partly correlate with outcrops of the Whin Sill. Declines are apparent from inspection of recent records. The species recorded from Natural Areas 1 and 2 are listed in **Table 6** and the relevant extract is given below.

Habitat surveys

The Grassland Inventories include few records of acid grasslands for Cleveland and Tyne & Wear, and all but three of the acid grasslands noted in Durham are in upland areas in the west of the county. Only Northumberland has significant records of lowland acid grassland, with the distinctive Whin Sill grasslands being recorded as small patches across the Border Uplands and the Northumberland Coastal Plain.

There have been several surveys of the Whin Sill grasslands. The only survey to utilise the NVC is Dalby (1991). This examined 8 of the 97 site visited by previous surveys. The grassland of greatest interest grows on shallow rankers developed over shelves or ledges of whin stone. The acidity is very variable with acidic and base rich grassland being found in close proximity. The acid stands are clearly referable to Festuca-Agrostis-Rumex grassland (U1). Affinities to the Erodium-Teesdalia sub-community (U1c) and to the lichen-rich sub-community (U1a) are suggested, but from the data given most stands would be more comfortably classified as the Typical sub-community (U1b) with tendencies to U1c. On more base rich areas, the U1 passes into communities related to Festuca-Hieracium-Thymus grassland (CG7) and on coastal cliffs into Festuca-Armeria maritime community (MC8). Distinctive species include *Allium schoenoprasum*, *Dianthus deltoides*, *Astragalus danicus*, *Moenchia erecta*, *Alchemilia gracilis* (RDB species), *Trifolium arvensis*, *Trifolium scabrum*, *Trifolium striatum*, *Myosotis ramosissima*, *Sagina subulata*, *Scleranthus annuus*, *Sedum villosum* and *Vulpia bromoides*.

Summary of consultations with Local Team Conservation Officers

Other than the presence of parched acid grassland in a few favourable situations in the lowlands, there is little difference in composition between the acid grasslands of the lowlands and the uplands. In the north east, lowland acid grassland is taken as grassland in the lowlands beyond the hills. A Phase 1 survey was carried out for Durham in 1995 and an extrapolation from this suggests that there is less than 300ha of lowland acid grassland in the north east as a whole. Moist acid grassland (U4) occupies about 75% of this area and is not much different from upland acid grassland, except that it is more fragmented. Most of the rest is parched acid grassland (U1). Deschampsia flexuosa grassland (U2) is probably only abundant at a single site. The grassland is fragmented with about 70-75% on the Coal Measures, 10% on the Northumberland Coastal Plain, less than 5% on the Magnesian Limestone and 10% in the Border Uplands. On the Coal Measures, acid grassland is associated with the more acid sandstones and often occurs with heathland. A few areas of acid grassland occur on drift over the Magnesian Limestone.

The Whin Sill grasslands are much more distinctive than the above grasslands, with a range of communities that are not well described by the NVC, but which include U1 and a rich and important flora. The Whin Sill sites include a mix of grazed and ungrazed sites. Grazing is essential if the full interest of the habitat is to be retained. Sheep grazing has been restored to some sites on nature reserves but there have been some problems with sheep over-grazing ledges.

Mining waste and derelict land frequently results from modern open-cast mining and former deep-mining. The restoration of heathland on this land is encouraged. There is often little grassland of interest on older waste sites.

29.4 Summary of resource

Extent and composition

Lowland acid grasslands are not extensive in the north east of England, and beyond the Whin Sill is of limited floristic diversity. The Whin Sill grasslands are of necessity, restricted by their specialised habitat, but are much more floristically diverse.

Conservation value

The Whin Sill grasslands are of great conservation value as northern outposts of southern acid grassland communities. The rest of the acid grasslands are of lower botanical interest except for the association of small areas of acid grasslands with some of the few surviving Magnesian Limestone grasslands. These acidic patches set the much reduced, but still important, calcicolous grasslands of the Magnesian Limestone in their ecological context.

29.5 Future requirements for survey and conservation

Survey

Although there has been much survey work on the Whin Sill there is a lack of detailed Phase 2 recording at an appropriate scale and of sufficient detail to be of value in assessing the national significance of sites and for monitoring purposes. This is felt to be a serious problem by the EN Local Team given the importance of the Whin Sill. Also, if the NVC affinities of the Whin Sill vegetation and its conservation value are to be fully determined, more intensive sampling is required than was carried out by Dalby (1991) and it should extend to non-SSSI sites. The interest of the saxcicolous bryophytes and lichens on the Whin Sill are not known and a small sample survey of sites would be worthwhile.

Conservation

Current conservation work on the Whin Sill should continue and could be extended to include reintroductions of species which have been lost from some sites.

29.6 References

DALBY, G. 1991. *Botanical survey of selected Whin grassland sites within Northumberland.* Newcastle: English Nature.

Extract from Table 6 for North East England: occurrence of plant species generally faithful to lowland acid grassland

County: North East England	
Natural Areas:	**1 + 2**
Dianthus deltoides	1
Filago minima	1
Moenchia erecta	1
Ornithopus perpusillus	1
Potentilla argentea	1
Sagina subulata	1
Stellaria pallida	1
Teesdalia nudicaulis	1
Trifolium scabrum	1
Trifolium striatum	1
Vicia lathyroides	1
Total no. of species extant	**11**
Total no. of species extinct	**0**
Total no. of species recorded	**11**

1 + 2 = North Northumberland Coastal Plain & Border Uplands Natural Areas

1 = Recent record
0 = Apparently extinct

North East England acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventories:										
Cleveland		1991	Field, enclosure relic	Tiny areas recorded	3	4.6	3.3	3.0		
Durham		1984-87	Field, Drift/calcicolous	All but 3 in NA 5 & 6 are upland grasslands	26	14169.9	53.3	2.8		
Northumberland		1981-92	Mainly Rock on Win Sill outcrops	Mainly NA 2 & 4 on Whin Sill	70	749.4	37.5	0.9		
Tyne & Wear		1986-90	Field	A few sites in NA5	4	94.4	NI	NI		
Heathland Inventories:										
Cleveland				No data						
Durham		1991-4	Enclosure relic	Mainly upland fringe sites in NA5	45	1157.0			99.1	
Northumberland		NI	Enclosure relic, Coast and Rock	Scatter of sites	13	4184.0			31.0	
Tyne & Wear		1985-93	Woods and Fields?	Small fragments	7	174.0			2.4	
Estimates, ha		1996		Stuart Hedley, English Nature				<300		
Estimates, classes		1996		Stuart Hedley, English Nature				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv:																						
Cleveland																						
Durham																						
Northumberl'd																						
Tyne & Wear																						
Heathland Inv:																						
Cleveland																						
Durham																						
Northumberl'd																						
Tyne & Wear																						
Estimates, ha	c75							+					c225									
Estimates, class	B	?	+	?				A				C	+				+					

Key

Column headings

GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland

H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates

A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha

F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

30. North Yorkshire

30.1 Physical

Geology

The hills of the Pennines to the west of the county are formed of Millstone Grit and Carboniferous Limestone. The Magnesian Limestone forms a band along the eastern edge of the Pennines, with Triassic and Permian sandstones and mudstones underlying the Vale of York. To the north east, the low Chalk hills of the Wolds are just included, with a narrow band of Lower Cretaceous deposits outcropping on their northern edge. The Vale of Pickering is on Jurassic clays and the North Yorkshire Moors are formed of Jurassic deposits. Glacial drift, including sands, are prominent, especially in the Vale of York.

Soils

In the Pennines and the North York Moors, all areas except for the valley bottoms are dominated by upland complexes of soils. The lowlands of the county are dominated by surface water and ground water gleys but there are localised areas that are dominated by drier acid soils. Areas dominated by podzols and brown sands are present in the Vale of York and a strip of brown sands exists along the southern edge of the Vale of Pickering (**Map 1e**).

30.2 Landscape history

19th Century

The 1850's 1 inch OS map shows a largely enclosed lowland landscape. However, in the southern part of the Vale of York, a few large areas of heathland remained at Skipwith Common and Strensall Common.

Current landscapes and Natural Areas

The lowlands are flanked to the west and east by the Yorkshire Dales and North York Moors Natural Areas (NA8 & NA17) and the Pennine Dales Fringe (NA15). The limestone and chalk are split off as the Southern Magnesian Limestone and the Yorkshire Wolds Natural Areas (NA23 & NA19 respectively), leaving the rest of the county in Vale of York and Mowbray Natural Area (NA16), the Vale of Pickering Natural Area (NA18) and part of the Humberhead Levels Natural Area (NA22). Of all these Areas, the latter three are alone in having soils recorded which have the potential to support lowland acid grassland.

30.3 Existing information

Flora

The coincidence maps (**Maps 2-4**) of lowland acid grassland species listed in **Table 1** show concentrations on the acid soils of both the Vales of York and Pickering, but few post-1970 records exist. A list of Table 1 species for Natural Areas NA16, 18 and part of NA22, including the former Humberside, is given in **Table 6** and the relevant data is extracted below.

Habitat surveys

The Grassland Inventory includes many acid grasslands recorded in the upland Natural Areas (NA8 & 17) and some in the Wolds (NA19), all areas for which there are no characteristic lowland acid grassland species recorded. Acid grassland has not yet been recorded for areas where a characteristic flora occurs.

English Nature's data set for Chalk grassland shows that "acid grasslands" of the Wolds are recorded as a transition community MG5b/U4. The Heathland Inventory shows two large heathlands surviving in the Vale of York; Skipwith Common and Strensall Common.

Summary of consultations with Local Team Conservation Officers

In the Yorkshire Dales Natural Area (NA8) and the Pennines Dales Fringe Natural Area (NA15), acid grassland occurs around the 300m level. It is mostly U4 and U5, and is best regarded as upland. The North York Moors contain between 100-500ha of Deschampsia flexuosa grassland (U2) and 500 to 1000 ha of moist acid grassland (U4). Acid grassland has a patchy distribution over the Moors, and tends to occur on edges of sites such as heathland commons and in valleys between moors. EN and the North York Moors National Park have carried out recent survey work of the unenclosed moorland. There is about 7,500 ha of acid grassland in the North York Moors National Park, including U2, U4, U5, U6 and U20. U20 is the most abundant, covering more than 6,000 ha.

Outside the uplands and upland fringes of the Dales and North York Moors, acid grassland occurs locally. Small areas exist in the Lower Derwent Valley National Nature Reserve but the majority is found with heathland such as at Skipwith and Strensall Commons in the Vale of York and Mowbray (NA16). These acid grasslands occur on blown sands similar to those of the North Lincolnshire Coversands and Clay Vales Natural Area (NA 34), and are covered by the same WES to promote positive management on SSSIs.

30.4 Summary of resource

Extent and composition

The status of the North York Moors acid grasslands is not clear. They may be at lower altitude than those of the Dales but the rarity of lowland acid grassland species suggests that they would be better regarded as part of an essentially upland landscape and as upland fringe grasslands. Their significance is likely to be related to the moorland to which they are adjacent, and they are not included in the estimates in this report.

There is less than 20ha of acid grassland, or transitions with neutral grassland in the Wolds. The resource in the Vale of York and Humberhead Levels has yet to be assessed but these appear to be the only areas with any fully developed lowland acid grassland. The total area is thought to be well under 50ha.

Conservation value

The surviving grasslands associated with heathland in the Vale of York and Humberhead Levels are probably the only lowland acid grasslands likely to be of more than county value.

30.5 Future requirements for survey and conservation

Survey

The highest priority is the need to assess the lowland acid grassland and its characteristic flora in the Vale of York and Humberhead Levels. This survey will determine what remains of the county's once rich lowland acid grassland flora.

Conservation

The available evidence indicates that heathland and associated lowland acid grassland have suffered a great decline in both extent and quality. Restoring the quality of both these habitats should be a priority.

Extract from Table 6 for North Yorkshire: occurrence of plant species generally faithful to lowland acid grassland

County: North Yorkshire	
Natural Areas:	**16 + 18 + 22 (part)**
Chamaemelum nobile	0
Dianthus deltoides	1
Filago minima	1
Hypochaeris glabra	0
Moenchia erecta	0
Potentilla argentea	0
Stellaria pallida	1
Teesdalia nudicaulis	1
Trifolium scabrum	1
Trifolium striatum	1
Vicia lathyroides	1
Total no. of species extant	**7**
Total no. of species extinct	**4**
Total no. of species recorded	**11**

16 + 18 + 22 = Vale of York and Mowbray, Vale of Pickering + Humberhead Levels (part)

1 = Recent record
0 = Apparently extinct

North Yorkshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1982-93	Fields, drift/calc	Most in upland fringe (NA8 & 17) few in NA19	62	470.0	63.5	6.0		
Heathland Inventory		1984-92	Heath	Two large heaths in NA16	3	916.9			150.0	
Estimates, classes		1996		Dave Clayden, English Nature				A		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Estimates, class	A																					

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

31. Nottinghamshire

31.1 Physical

Geology

Most of the county occurs on Permian and Triassic sediments, although some Coal Measures lie on its extreme western edge, and a larger area of Jurassic Lias clays are present in the east. To the west there is a north to south band of Magnesian Limestone, with sandstones in the centre, and mudstones to the east. Drift and alluvial deposits include river gravels and in the east and patches of blown sand known as Coversand.

Soils

The sandstones north of Nottingham support the largest single area dominated by brown sands in the country, and also some areas dominated by podzols. North of Newark there are small areas of brown sands developed on blown sand (**Map 1e**).

31.2 Landscape history

19th Century

The 1820's and 1830's 1 inch OS maps show a county which was largely enclosed. North of Nottingham, the brown sands were occupied by parks and the recently enclosed landscape of Sherwood Forest.

Current landscapes and Natural Areas

The county includes all of the Sherwood Natural Area (NA32) which encompasses the enclosed heathland landscape. Much of the rest of the county is within the Trent Valley and Rises Natural Area (NA33) but the Humberhead Levels Natural Area (NA22) just enters the county in the north. Parts of the Southern Magnesian Limestone and the Coal Measure Natural Areas (NA23 & NA24 respectively) occupy the far west of the county.

31.3 Existing information

Flora

The coincidence maps (**Maps 2-4**) of lowland acid grassland species listed in **Table 1** show concentrations of lowland acid flora recorded in the Sherwood Natural Area, the Trent Valley between Newark and Nottingham and most particularly, on the Coversand. This extends beyond Nottinghamshire and falls largely into NA22 and NA34 (North Lincolnshire and Coversands and Clay Vales). The Coversand and Sherwood Forest still have surviving floristic interest but the Trent Valley appears to have little interest left. The flora of Sherwood Forest includes a reasonable selection of acid grassland species and outlying stations for the southern Dwarf Gorse, *Ulex minor*. The Coversand in Nottinghamshire supports the rare *Festuca longifolia* and *Carex arenaria*. Lists of the lowland acid grassland species recorded from Sherwood and the Coversand of NA34 and 33 areas are given in **Table 6** (relevant extract given below).

Fauna

The English Nature Local Team reports that the U2 grasslands of Sherwood do have a considerable invertebrate interest, particularly the rich spider fauna in the *Deschampsia flexuosa* grassland (U2) at Birklands & Bilhaugh SSSI. This site supports an assemblage which has affinities with the Breckland grass heaths and countains both national and regional rarities.

Habitat surveys

The Grassland Inventory includes some sites on the Magnesian Limestone, in the Trent Valley and in Sherwood Forest, although the grassland in the heathlands of Sherwood Forest have been omitted. The Heathland Inventory includes sites in Sherwood Forest and the Coversand area.

Many of the heathlands of Sherwood Forest were surveyed by Soden (1991) and the *Deschampsia* grass heaths (U2) were included in the survey. The survey specifically excluded any areas dominated by the more species-rich parched acid grasslands (U1). A total of 142.2ha of U2 was recorded and tiny amounts of *Nardus* grassland (U5). The U2 grassland is quite species-poor but provides the local locus for *Ulex minor* and the northern lichen *Icmadophila ericetorum*. A photograph in the report of short, grazed, U2 grassland at Walesbury Forest contrasts greatly to the more typical rank, tussocky, ungrazed *Deschampsia* grassland.

The biological survey of common land (Francis *et al*, 1990) recorded a few derelict sites as acid grassland all of which appear to be rank neutral grassland (MG1) rather than acid grassland.

Summary of consultations with Local Team Conservation Officers

Parched acid grassland (U1) and moist acid grasslands (U4) are restricted in area and have a probable extent of less than 50ha. The *Deschampsia flexuosa* grass heaths (U2) cover between 100-200ha and are mostly found in Sherwood Forest. The grass heath is thought to have increased at the expense of heath and there is a desire to increase the proportion of Heather cover.

Parched acid grasslands are very fragmentary, with the best site in Spalford Warren on the Coversand, where *Festuca longifolia* occurs. This site includes *Carex arenaria* dune and is in the process of being restored. The Trent Valley now only has secondary U1 in gravel pits.

The Coal Measures have stands transitional between U4b and MG5c (9ha in extent), which are a distinctive local feature of considerable interest found in juxtaposition with acid grassland (U4b) and more base rich grasslands (MG5a & CG4). A tiny amount of U2 occurs in the Humberhead Levels.

In Sherwood Forest, grazing is being restored to Clumber Park. Heathland is being restored on coal waste and more heathland management on Forest Enterprise land is now carried out. Sheep are currently used, but with high levels of public access, this is not without its problems. Cattle may therefore be used in future. Scrub clearance is being done and soil stripping is being used to reduce the amount of *Deschampsia flexuosa*.

31.4 Summary of resource

Extent and composition

The county includes small but important fragments of the Coversand grassland and less diverse *Deschampsia* grass heaths (U2) in the Sherwood Forest heathlands. The latter area has a reasonable acid grassland flora and is very likely to have some parched acid grassland. However, little information exists about it. Beyond these areas, the extent and flora of the acid grasslands appears to be very limited.

Conservation value

The Coversand sites are a significant part of the nationally important acid grasslands of the Coversand which extend into other counties. The grasslands of Sherwood Forest are an integral part of the heathlands here but may be of lower intrinsic significance. The acidic MG5c and transitions to U4 on the Coal Measures are a distinctive local feature.

31.5 Future requirements for survey and conservation

Survey

The County Council are to carry out a survey to identify SNCIs. This survey should ideally include NVC vegetation mapping as well as species lists. The most pressing requirement is to locate and characterise any parched acid grassland stands. Detailed Phase 2 surveying is required on the main Coversand sites to inform management decisions and monitor condition of these areas.

Conservation

The highest priority for acid grassland conservation is to conserve and extend the Coversand heathland and grassland. The ongoing work in Sherwood Forest should aim, where possible, to recreate a more varied and sustainable heathland ecosystem than currently exists.

31.6 References

FRANCIS I.S., PENFORD, N., FINCH, M. & AITCHISON, J.W. 1990. *Biological survey of common land No 11: Nottinghamshire.* Peterborough: Nature Conservancy Council.

SODEN, D.W. 1991. *A vascular plant survey of selected Nottinghamshire heathlands - Summer 1990.* Grantham: Nature Conservancy Council, East Midlands Region.

Extract from Table 6 for Nottinghamshire: occurrence of plant species generally faithful to lowland acid grassland

County: Nottinghamshire		
Natural Areas:	34 + 33	32
Grasses		
Apera interrupta	1	
Festuca longifolia	1	
Other Vascular Plants		
Crassula tillaea	1	
Filago minima	1	1
Hypochaeris glabra	1	1
Moenchia erecta	0	0
Ornithopus perpusillus	1	1
Potentilla argentea	1	1
Stellaria pallida	1	
Teesdalia nudicaulis	1	1
Trifolium striatum	1	1
Trifolium subterraneum	1	
Vicia lathyroides	1	1
Total no. of species extant	**12**	**7**
Total no. of species extinct	**1**	**1**
Total no. of species recorded	**13**	**8**

34 + 33 = North Lincolnshire Coversands and Clay Vales and Trent Valley and Rises (includes records from other counties)
32 = Sherwood

1 = Recent record
0 = Apparently extinct

Nottinghamshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1987-94	Field, Enclosure relic, waste	Excludes heathlands	11	175.0	128.5	116.8		
Heathland Inventory		1985-91	Heath, Enclosure relic	All in NA 33 & 32	33	3840.0			183.3	
Notts Heathland Phase 2		1991	Heath, Enclosure relic	Survey of selected heaths in NA32 (Soden, 1991)	17		182.5	142.7	40.3	
Common Land Survey		1990	Common	Most derelict and now MG1, not acid grassland	4	26.7	13.85	2.8	6.7	
Estimates, ha		1996	Also Waste, Fields	Ian Butterfield, EN						
Estimates, classes		1996		Ian Butterfield, EN				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Notts Heath								142.2	142.2									0.5				
Common Land																						
Estimates, ha	< 50											< 10		< 10						c10		
Estimates, class	A		A			A		C	C			A		A				A		A		

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

32. Oxfordshire

32.1 Physical

Geology

The youngest rocks in Oxfordshire are small relics of Tertiary sands and clays left as patches in the Chalk of the Chilterns. North of the Chalk, the county is dominated by Lower Cretaceous and Jurassic clays & limestones but some sand outcrops are found south and south west of Oxford where fragments of Lower Greensand and outcrops of sandy Corallian limestone occur.

Soils

Oxfordshire is dominated by surface water gleys, brown earth soils and rendzinas but small areas of brown sands occur south of Oxford (**Map 1b**).

32.2 Landscape history

19th Century

In the 1830's there were still small areas of common on the sand areas near Oxford and frequent small commons on the Chilterns.

Current landscapes and Natural Areas

Three of English Nature's Natural Areas (the Thames and Avon Vales ((NA63), the Berkshire and Marlborough Downs (NA79) and the Cotswolds (NA55)) have very limited potential for acid grassland. However, the Midvale Ridge Natural Area (NA64) has areas of brown sand and a few areas of semi-natural vegetation, whilst areas of common on the dip slopes of the Chilterns (NA65) could once have supported some acid grassland.

32.3 Existing information

Flora

The coincidence maps (**Maps 2-4**) of lowland grassland species listed in **Table 1** show a high concentration in the area south of Oxford, plus a less prominent concentration on the Chilterns. However, there is evidence of a marked decline from inspection of post-1970 records.

The acid grassland flora of the Chilterns is limited, but the area south of Oxford in the Midvale Ridge Natural Area had a rich flora, with sixteen species recorded, of which six have no recent records. The best site is Frilford Heath, where grass heath with species such as *Silene conica* and *Dianthus deltiodes*, survives on a golf course. Lists of the lowland acid grassland species recorded from both Natural Areas are given in **Table 6** (relevant extract given below).

Fauna

The English Nature Local Team report that grass heaths at Frilford and Shotover are important for aculeate Hymenoptera.

Habitat surveys

The Grassland Inventory records three sites in the Midvale Ridge Natural Area, Frilford Heath, Sidlings Copse and Brasenose Wood and Shotover. The Heathland Inventory includes small heathland fragments in the Midvale Ridge and the Chilterns.

Summary of consultations with Local Team Conservation Officers

The area of acid grassland in Oxfordshire is very limited and extends to about 10-20ha. All of this is likely to be parched acid grassland (U1). The well known area at Frilford Heath has proved to be difficult to conserve within the golf course but a recent survey of the rarer species confirmed their continued existence. An attempt is being made to restore grass heath on adjacent farmland and if successful, should ensure the survival of the grass heath habitat. The other areas in the Midvale Ridge are very small but restoration work is being carried out at Brasenose Wood. The Chiltern Commons could have a little acid grassland and a recent Biological Survey of Common Land should help clarify this. The local Wildlife Trust, BBONT, are currently working on a heathland restoration project on the Oxford Chilterns Commons using Countryside Stewardship grant aid. The Hymenoptera fauna of the sand pits in the Oxford Heights is of interest.

32.4 Summary of resource

Extent and composition

The area of acid grassland in Oxfordshire is very limited but includes fragments of floristically very rich parched acid grassland. No NVC surveys have been carried out but presumably U1b is present, and possibly U1d.

Conservation value

The floristic importance of Frilford Heath is high in spite of its fragmented condition, and it is of considerable importance as an outlier of grassland assemblages more typical of the east of England, as well as having an unusual combination of habitats, from base rich fen through to acid grassland.

32.5 Future requirements for survey and conservation

Survey

There are no high priorities for survey although only limited resources would be required to carry out a NVC survey of the grassland that remains.

Conservation

The Frilford Heath area is a high priority for habitat restoration in general. Ideally, an area of extensively grazed grass heath and base rich fen should be restored. If successful, the complex would probably be of national importance.

Extract from Table 6 for Oxfordshire: occurrence of plant species generally faithful to lowland acid grassland

County: Oxfordshire		
Natural Areas:	**64**	**65**
Grasses		
Apera interrupta	1	
Other Vascular Plants		
Chamaemelum nobile	0	0
Dianthus deltoides	1	
Filago minima	1	
Hypochaeris glabra	0	1
Moenchia erecta	0	
Ornithopus perpusillus	1	1
Potentilla argentea	1	0
Silene conica	1	
Stellaria pallida	1	
Teesdalia nudicaulis	1	
Trifolium scabrum	0	
Trifolium striatum	1	1
Trifolium subterraneum	0	
Vicia lathyroides	1	
Viola lactea	0	
Total no. of species extant	**10**	**3**
Total no. of species extinct	**6**	**2**
Total no. of species recorded	**16**	**5**

64 = Midvale Ridge
65 = Chilterns

1 = Recent record
0 = Apparently extinct

Oxfordshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	HLA
Grassland Inventory		1986, 94	Two are probably Heath relics	All three sites in Midvale Ridge NA	3	142.4	NI	NI		
Heathland Inventory		1986, 95	Heath relics, Commons, Calcicolous	In Midvale Ridge & Chilterns NAs	11	575			23.6	0.2
Estimates, hectares		1996		Graham Steven, English Nature				10-20		
Estimates, classes		1996		Graham Steven, English Nature				A		

Survey Name	U1	U1a	U1b	U1c	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																					
Heathland Inv.																					
Estimates, Ha	10-20																				
Estimates, class	A		?																		

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

33. Shropshire

33.1 Physical

Geology

The north and east of the county is on Triassic and Permian sandstones and mudstones with outcrops of Coal Measures on the southern and western edge. The rest of the county is a complex mixture of Silurian, Ordovician, Cambrian and Precambrian rocks with a block of Old Red Sandstone in the south. Dolerite intrusions are found in the southern parts of the county. Glacial sands and gravels common in the lowlands to north and east.

Soils

The upland areas are dominated by brown podzolic soils, whilst brown sands and podzols are found on glacial drift in the north and east (**Map 1c**).

33.2 Landscape history

19th Century

The 1830 1 inch OS map shows a scatter of small to medium-sized heathland commons in the north and east of the county. Sinker *et al* (1985) indicates that many others had been enclosed in the decades before this date. These commons were mostly associated with the podzol and brown sand-dominated areas. The uplands, then as now, had large areas of moorland.

Current landscapes and Natural Areas

The lowlands are divided between the The Mosses & Meres and the Midlands Plateau Natural Areas (NA27 & NA43 respectively). Both have widespread areas of acid soils, that are now virtually all within enclosed farmland.

The uplands are divided between the small Ostwestry Uplands Natural Area (NA41) in the west, the Shropshire Hills (NA42) and the Clun and North West Herefordshire Hills Natural Area (NA58). The Shropshire Hills are characterised by thin soils on south-facing rock outcrops, with a specialised flora which is rarer in the Clun.

33.3 Existing Information

Flora

The coincidence maps (**Maps 2-4**) of lowland grassland species listed in **Table 1** show that a considerable concentration has been recorded from in, and around, the Shropshire Hills. Despite a decline, the post-1970 records still show a notable number of records. The lowland acid grassland species recorded from the Natural Areas of Shropshire are listed on **Table 6**, the relevant parts of which are shown below.

The Ecological Flora of the Shropshire Region (Sinker *et al*, 1985) describes the lowland acid grassland flora, which is regarded as an important feature of the region. Coincidence maps of species of 'warm rocky slopes' are given using twelve species: *Aira caryophyllea*, *Cerastium semidecandrum*, *Dianthus deltoides*, *Filago minima*, *Jasione montana*, *Lepidium heterophyllum*, *Moenchia erecta*, *Ornithopus perpusillus, Sedum fosteranum, Spergularia rubra, Teesdalia nudicaulis* and *Trifolium striatum.*

This coincidence map shows very localised concentrations of these species, most of which are found in the Shropshire Hills, especially the east side of Long Mynd and Caer Caradoc and just over the Welsh border, including the important Briedden Hill. Here these species are typically found on steep slopes, on igneous rocks, volcanic ashes, or hard Precambrian sediments.

The Clun and North West Heredfordshire Hills have a scatter of sites and there are additional sites at Earls Hill (SJ4004) just north of the Shropshire Hills. To the north and east there is limited survival from the once extensive heaths of the lowlands, with Prees Heath (SJ5436), a broken up concrete runway on a former heath in the north, and the Bridgnorth area (SO7288 & 7488), on a sandstone outcrop in the east. Other species characteristic of this habitat include *Umblicus rupestris, Carlina vulgaris, Sedum anglicum* and *Scleranthus annuus polycarpos.*

Sinker *et al* (1985) also produce quadrat data which indicates that these species are found in parched acid grassland (U1), including the Typical sub-community (U1b), the Hypochaeris sub-community (U1f) and the Galium-Potentilla sub-community (U1e).

Associated habitats include consolidated dolerite scree with *Sedum fosteranum, Umblicus rupestris, Cladonia* species, *Scapania gracilis, Dicranum scoparium, Geranium lucidum* and other species. This chasmophytic vegetation does not appear to be described by the NVC and is probably related to the scree vegetation described below in the section on Somerset.

Over the border in Wales, the cliffs of Briedden Hill support further chasmophytic communities with *Lychnis viscaria* (RDB sp), *Potentilla rupestris* (RDB sp), *Veronica spicata* (RDB sp), *Filipendula vulgaris* and *Geranium sanguineum* as well as the bryophytes *Bartamia stricta* (RDB sp), *Frullania fragilifolia, Pterogonium gracile* and *Targionia hypophylla.* Although no Shropshire site is as rich as this, *Geranium sanguineum* occurs at some sites.

Interestingly the Stiperstones area stands out for its total lack of lowland acid grassland species and for its very upland character with *Vaccinium vitis-idaea* and *Empetrum nigrum* frequent.

Waste sites can also develop acid grasslands. These include parched acid grassland developed on disturbed former heathland and dolerite quarries. They can include characteristic local species such as *Dianthus deltiodes, Lepidium heterophyllum, Sedum fosteranum, Filago minima, Ornithopus perpusillus* and *Parentucellia viscosa.* Coal shale pit mounds near Telford support impoverished heath and *Deschampsia flexuosa* grassland (U2), whilst much richer vegetation is found in open cast coal and clay workings at Coalbrookdale, which includes acid communities. Here one small area supports three clubmosses species: *Diphasiastrum alpinum, Huperzia selago* and *Lycopodium clavatum.*

Habitat surveys

The Grassland and Heathland Inventories record a scatter of sites across the county. A Phase 2 grassland survey of Shropshire (Wrench, 1995) concentrates on neutral grassland and fen meadows and appears only to have recorded acid grasslands when associated with the target habitats. A total of 1.7ha of parched acid grassland is recorded, mainly of the Lotus-Anthoxanthum sub-community (U1d), 8ha of moist acid grassland (U4), of which 3.95 was identified as the Typical sub-community (U4a) and 3.2ha of *Nardus* grassland (U5).

A monitoring survey of Earls Hill and the Lump includes quadrat data recorded from an example of Festuca-Agrostis-Rumex grassland Typical sub-community (U1b) on the south facing side of the hill and form a Festuca-Agrostis-Rumex grassland Galium-Potentilla sub-community (U1e) on the north side. Species of interest include *Carlina vulgaris*, *Jasione montana*, *Teesdalia nudicaulis* and *Moenchia erecta*.(Chris Walker, pers. comm. 1996)

At the Lump, the quadrat data records a rich community that is probably closest to Festuca-Agrostis-Rumex grassland Hypochaeris sub-community (U1f), but mixed with Lotus-Anthoxanthum sub-community (U1d) species. *Thymus polytrichus* is a constant, but otherwise there is no particular relationship to the Festuca-Agrostis-Thymus grassland (CG10). Species of interest that are present include *Dianthus deltoides*, *Sedum forsteranum*, *Vulpia bromoides*, *Trifolium striatum*, *Jasione montana* and *Moenchia erecta*.

Summary of consultations with Local Team Conservation Officers

'Lowland' acid grassland is rather difficult to define as U1 grassland can occur in upland situations. The communities U4, U5 and U6 are common in unenclosed upland grasslands but within these communities, parched acid grasslands with southern floras can occur on favourable, south-facing, shallow soils. In enclosed areas, U4 is fairly widespread and probably extends to over 100ha. The parched acid grasslands (U1) occur on similar rock outcrops to those in the uplands, as well as on the Triassic sandstones, on valley sides river terraces and in old parkland in the east of the county. Deschampsia flexuosa grassland (U2) occurs locally within heathland relics.

33.4 Summary of resource

Extent and composition

The presence of U1 grasslands in the uplands of Shropshire is best regarded as the extension of lowland acid grassland where favourable conditions permit. These parched acid grassland are the most species-rich acid grasslands in the county and cover an approximate 50-100ha. The moist acid grasslands (U4), extend into the upland fringe in enclosed fields, and are likely to cover at least 100ha.

Conservation value

The parched acid grasslands are of high nature conservation value. They form part of a series of north western outliers of this southern community, and reach their greatest development in the Welsh dolerite hills, where rare chasmophtyic species are also found. The other acid grassland types are generally only regarded as being of particular conservation value where they form mosaics with neutral grasslands or heaths.

33.5 Future requirements for survey and conservation

Survey

Enclosed grasslands are well surveyed, to the point that only limited new grasslands of interest are likely to be found by more survey work. However, the parched acid grasslands of steep slopes have not been well covered and a specific survey to fully ascertain their extent and quality is required.

Conservation

The upland U1 grasslands are relatively secure but the effects on these grasslands of any measures to counteract over grazing should be considered; they may benefit from heavy grazing. The heathlands of the north and east have suffered catastrophic losses and any opportunities to extend and restore what is left should be followed up.

33.6 References

SINKER, C.A., PACKHAM, J.R., TRUEMAN, I.C., OSWALD, P.H., PERRING, F.H. & PRESTWOOD, W.V. 1985. *Ecological flora of the Shropshire region.* Shrewsbury: Shropshire Trust for Nature Conservation.

WRENCH, D.H. 1995. *Botanical survey of semi-natural grasslands in Shropshire.* Shrewsbury: English Nature, West Midlands Team.

Extract from Table 6 for Shropshire: occurrence of plant species generally faithful to lowland acid grassland

County: Shropshire				
Natural Areas:	**43 (part)**	**58**	**42**	**27**
Chamaemelum nobile		0		0
Dianthus deltoides	0	1	1	1
Erodium maritimum	0			
Filago minima	1	1	1	1
Hypochaeris glabra	1		1	1
Moenchia erecta	1	1	1	1
Ornithopus perpusillus	1	1	1	1
Potentilla argentea	0		1	1
Stellaria pallida	1			1
Teesdalia nudicaulis	1	1	1	1
Trifolium scabrum				0
Trifolium striatum	1	1	1	1
Vicia lathyroides	1	1		
Total no. of species extant	**8**	**7**	**8**	**9**
Total no. of species extinct	**3**	**1**	**0**	**2**
Total no. of species recorded	**11**	**8**	**8**	**11**

43 = Midlands Plateau (part)
58 = Clun and North West Herefordshire Hills
42 = Shropshire Hills
27 = Mosses and Meres

1 = Recent record
0 = Apparently extinct

Shropshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1981-95	Fields, Enclosure relic, Rock	Recorded sites scattered across the county	46	306.7	120.7	17.9		
Heathland Inventory		1988-93	Heath, Enclosure relic, Waste	Recorded sites scattered across the county	46	1700.0			208.9	
Phase 2		1995	Fields	Wrench (1995), mainly recorded neutral grassland				12.9		
Estimates, classes		1996		Chris Walker, English Nature				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Phase 2	1.7				1.7							8.0	4.0					3.2				
Estimates, class	B		+		+	+	+	A	A			C	+					A				

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

34. Somerset

34.1 Physical

Geology

The varied geology of Somerset includes outcrops of harder, old rocks, in the west. Devonian and Carboniferous sandstones underlie Exmoor and the Quantock Hills. In the north east, the Mendips are on Carboniferous limestones. Permian and Triassic sandstones and mudstones and Jurassic clays and limestone underlie the lowlands, with Lower Cretaceous Upper Greensand covering these deposits in the south east to form the Blackdown Hills.

Soils

The soil map shows extensive areas of brown podzolic soils and stagnopodzols in the uplands of the west. Elsewhere, only small areas of podzols are recorded on the summits of the Mendips (**Map 1a**).

34.2 Landscape history

19th Century

The 1800 and 1810 1 inch OS maps show large blocks of moorland on Exmoor and The Quantock Hills. Beyond the uplands, areas of heathland were mainly confined to the summits of the Mendips and the Blackdown Hills.

Current landscapes and Natural Areas

The upland areas of the west are included within the Exmoor and The Quantocks Natural Area (NA87). The moorland of Exmoor is still extensive but more fragmented than in the early 19th century. In the Mendips and in the Blackdowns Natural Areas (NA84 & NA89 respectively), most of the heathland recorded in the 19th century is no longer present.

34.3 Existing information

Flora

The coincidence maps (**Maps 2-4**) of lowland acid grassland species listed in **Table 1** show that Somerset has few concentrations, with the only notable areas along the coast. However, the total flora is fairly impressive with 20 species recorded, of which two are apparently extinct. The lowland acid grassland species recorded for the county are listed in **Table 6** with the relevant extract shown below.

The Flora of Somerset (Roe, 1981) indicates that many of the acid grassland species are confined to sand dune systems, such as Minehead Warren. Elsewhere, the frequency of *Sagina subulata* in the west is notable. The Blackdowns have an impoverished lowland acid grassland flora.

Fauna

The English Nature Local Team reported that the Robber Fly, *Asilus crabroniformis*, a species listed in the Biodiversity Action Plan, occurs on Exmoor.

Habitat surveys

The Grassland Inventory records acid grassland on Exmoor and in the Blackdowns, and on the Mendips on drift over limestone. The Heathland Inventory includes a large amount of moorland on Exmoor and on The Quantock Hills and some lowland heathland on the Blackdowns and the Mendips.

The Biological Survey of Common Land (Hedley & Aitchison, 1992) mostly covers upland commons but indicates the presence of some U4 on the Mendips and some parched acid grassland (U1) with *Ornithopus perpusillus* and *Aphanes inexspectata* in a quarry on the edge of The Quantocks.

The enclosed land on Exmoor (including Devon as well as Somerset) has been covered by a Phase 2 survey and report (Butcher & Stewart, 1990). The survey records 267.4ha of U4, 56.4ha of U1, 14.1ha of U2 and 1.7ha of U3. The report gives no description of the floristics of the acid grasslands or details of their conservation value. The parched acid grasslands (U1) were found at lower altitudes and were the most species-rich type of acid grassland.

A similar survey has been carried out in the Blackdown Hills (Butcher, 1987). This was done before any draft of the NVC acid grassland classification was available and no attempt was made to describe the 42ha of acid grassland recorded. Acid grasslands were said to form a high proportion of the vegetation of the Blackdowns but only species-rich examples were surveyed. (Data from Dorset was also included.)

Summary of consultations with Local Team Conservation Officers

Most enclosed acid grassland is in Exmoor and is covered by Butcher & Stewart (1990). Associated with some of the acid grasslands are herb-rich bracken stands which can support fritillary butterflies and the small ferns *Ophioglossum vulgatum* and *Botrychium lunaria*. The Blackdowns probably have about 200ha of acid grassland, of which much is probably U4. However, EPR is aware of some U3 in heathland mosaics. In the Quantocks most of the commons are heath or bracken with probably not more than a few hectares of U3 and U4.

One feature of interest is the scree communities of Old Red Sandstone sea cliffs (Mike Edgington, pers. comm. 1996). These have *Sedum anglicum* and *Dicranum scoparium* as constants and include a lichen rich sub-community. One sub-community has constant *Aira praecox* and *Festuca ovina* frequent. The latter stands closely approach U1, but the community is probably best regarded as undescribed in the NVC. Related communities occur on screes in Shropshire.

34.4 Summary of resource

Extent and composition

Somerset is characterised by the dominance of U4 and by the general floristic poverty of the U1 that exists, although a wide variety of acid grassland plants occur on coastal dunes. Most acid grassland is confined to Exmoor and the Blackdown Hills. There is acid grassland in the Mendips but this appears to be an unknown resource.

Conservation value

Most acid grasslands in Somerset appear to have relatively low intrinsic interest and their conservation value is mostly defined by their association with other habitats of value.

34.5 Future requirements for survey and conservation

Survey

There are no obvious high priorities for Phase 2 surveys of acid grasslands in Somerset, although the Mendips resource could usefully be assessed, along with the important calcareous communities in this Natural Area.

Conservation

No obvious priorities for conservation of acid grasslands, apart from maintaining them in mosaics with other habitats.

34.6 References

BUTCHER, B. & STEWART, A. 1990. *Grassland in the Exmoor National Park: a report of survey 1990.* Somerset Trust for Nature Conservation.

HEDLEY, S. & AITCHISON, J.W. 1992. *Biological survey of common land. No 22: Somerset.* Peterborough: English Nature.

SAUNDERS, G. & BUTCHER, B. 1987. *The grassland resource of the Blackdown Hills: its extent, classification and conservation potential.* Taunton: Nature Conservancy Council, South-West Region.

Extract from Table 6 for Somerset: occurrence of plant species generally faithful to lowland acid grassland

County: Somerset	
Natural Areas:	**All**
Grasses	
Vulpia ciliata ambigua	1
Other Vascular Plants	
Chamaemelum nobile	1
Crassula tillaea	1
Erodium maritimum	1
Filago minima	0
Hypochaeris glabra	1
Moenchia erecta	1
Ornithopus perpusillus	1
Sagina subulata	1
Silene conica	1
Stellaria pallida	1
Teesdalia nudicaulis	1
Trifolium glomeratum	0
Trifolium ornithopodioides	1
Trifolium scabrum	1
Trifolium striatum	1
Trifolium subterraneum	1
Trifolium suffocatum	1
Vicia lathyroides	1
Viola lactea	1
Total no. of species extant	**18**
Total no. of species extinct	**2**
Total no. of species recorded	**20**

1 = Recent record
0 = Apparently extinct

Somerset acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1986-90	Field, Drift/calcicolous, Common	Mainly NA87, 89, 84	21	574.9	NI	NI		
Heathland Inventory		1984-94		Includes some upland sites	28	17650.0			251.4	
Exmoor Survey		1990		Butcher & Stewart (1990) Phase 2 survey	53		1250.3	340.2		
Blackdowns Survey		1987		Butcher (1987) Phase 2 survey				42.0		
Estimates, ha		1996		Dr Flemming Ulf-Hansen & Mike Edgington, EN				500+		
Estimates, classes		1996		Dr Flemming Ulf-Hansen & Mike Edgington, EN				D		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Exmoor Survey	56.4							14.7			1.7	267.4										
Blackdowns																						
Estimates, ha	56+							40+														
Estimates, class	B							A			B	C										+

Key

Column headings

GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates

A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

35. South Yorkshire

35.1 Physical

Geology

The Dark Peak to the west of the county is composed of Millstone Grit and the centre is occupied by a wide exposure of the Coal Measures. Magnesian Limestone forms a narrow band in the east, with Sandstone in the extreme east. The latter area has deep recent alluvial deposits.

Soils

The hills of the Dark Peak to the west have upland soils with surface water gleys, while brown earths dominate the Coal Measures. To the east of Doncaster, the recent deposits include areas of brown sands (**Map 1e**).

35.2 Landscape history

19th Century

The 1840's 1 inch OS map shows a largely enclosed lowland landscape.

Current landscapes and Natural Areas

The Natural Areas of the region closely follow the geology. The uplands to the west are part of the Dark Peak Natural Area (NA25), and this is followed eastwards by the Coal Measures Natural Area (NA24), the Southern Magnesian Limestone Natural Area (NA23) with the Humberhead Level Natural Area (NA22), covering the alluvial land of the eastern part of the county. The Coal Measures have become very urbanised.

35.3 Existing information

Flora

The coincidence maps (**Maps 2 to 4**) of lowland acid grasslands listed in **Table 1** show a concentration recorded from the east side of Doncaster, in the Humberhead Levels. The acid grassland species recorded from the Humberhead Levels (including records from beyond South Yorkshire) are listed in **Table 6** the relevant parts of which are extracted below. A total of 10 species have been recorded of which two are probably extinct. Sand sedge, *Carex arenaria* has also been recorded.

Habitat surveys

The Grassland Inventory records three acid grasslands on the Coal Measures and one on the Magnesian Limestone, both Areas have a very poor acid grassland flora. The Heathland Inventory records a scatter of heathland relics around Doncaster, which correlate with the rich acid grassland flora recorded on **Map 2**.

Summary of consultations with Local Team Conservation Officers

There are no acid grassland SSSIs and the extent of the resource is unclear, although the extent of good quality habitat is estimated at 10-50ha. It occurs mainly on the higher ground, as this rises towards the Pennines. U4 and U5 have been identified from the Coal Measures, where their distribution is patchy. Acid grassland around Doncaster are associated with remnant heathland.

35.4 Summary of resource

Extent and composition

It is clear that the Doncaster heathlands once supported a rich acid grassland flora although their current condition is not well known. However, the flora recorded from them suggests that parched acid grasslands (U1) and possibly *Carex arenaria* dune (SD11/12) are, or were, present. The Coal Measures support small areas of U4 and U5, and some acid grassland occurs on the Magnesian Limestone.

Conservation value

The acid grasslands of the Doncaster area are, or were, of considerable interest and were as rich as the acid grasslands of the Vale of York. The presence of *Carex arenaria* indicates a strong similarity to the flora of the Coversand to the east. The Coal Measures and Magnesian Limestone support floristically rather poor acid grasslands, and are of particular floristic interest where associated with richer neutral grassland or limestone grassland.

35.5 Future requirements for survey and conservation

Survey

The English Nature Local Team regard the Coal Measures and the Humberhead Levels as priorities for further survey. Although the Coal Measures may be a priority for survey of general, enclosed, grassland, which includes acid grasslands, it does not appear to EPR that they are of national priority for acid grassland survey. An assessment of the condition of the Doncaster heathlands and the current condition of the associated acid grassland flora is a higher priority.

Conservation

The heathlands of the Humberhead Levels are priorities for conservation and restoration.

Extract from Table 6 for South Yorkshire: occurrence of plant species generally faithful to lowland acid grassland

County: South Yorkshire	
Natural Area:	**22**
Dianthus deltoides	0
Filago minima	1
Hypochaeris glabra	1
Moenchia erecta	0
Ornithopus perpusillus	1
Potentilla argentea	1
Stellaria pallida	1
Teesdalia nudicaulis	1
Trifolium striatum	1
Vicia lathyroides	1
Total no. of species extant	**8**
Total no. of species extinct	**2**
Total no. of species recorded	**10**

22 = Humberhead Levels (may include records from outside South Yorkshire)

1 = Recent record
0 = Apparently extinct

South Yorkshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland inventory		1991-94	Enclosure relics & fields	Very little recorded	4	49.3	5.5	NI		
Heathland inventory		NI	Enclosure relics	Few areas calculated. Most in NA22	15	3544.0			8.0	
Estimates: classes		1996		Neil Sanderson, EPR, Colin Newlands, EN				A		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Estimates: class	A											A						A				

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

36. Staffordshire

36.1 Physical

Geology

The lowlands of Staffordshire are dominated by Permian and Triassic sandstones and mudstones but there are outcrops of Coal Measures at Cannock and the Potteries. The uplands of the north west are formed from Millstone Grit and some Carboniferous Limestone.

Soils

Staffordshire has extensive patches of brown sands and podzols in the south west and at Cannock Chase, with smaller patches in the upland fringes to the north (**Maps 1c** & **1e**).

36.2 Landscape history

19th Century

The 1830's 1 inch OS maps show the extensive heathlands of Cannock Chase and a scatter of unenclosed heathlands. There are also signs of enclosed, former, heathlands in the west and south west.

Current landscapes and Natural Areas

The south of the county is part of the Midlands Plateau Natural Area (NA43) which, in spite of considerable urban development, still has significant areas of heathland. The lowlands to the north of this Natural Area are dominated by the Needwood and South Derbyshire Claylands Natural Area (NA40), but also include parts of the Mosses and Meres Natural Area (NA27) and the Trent Valley and Rises Natural Area (NA33), to the west and east respectively. These appear to have lost most of the heathlands which were once scattered throughout the area. To the north of the county, the uplands are divided between the upland fringe Potteries and Churnet Valley, the South West Peak, and the White Peak Natural Areas (NA28, NA29 & NA30 respectively), which occur on the Millstone Grit and Carboniferous Limestone.

36.3 Existing information

Flora

The coincidence maps (**Maps 2-4**) of lowland acid grassland species listed in **Table 1** show concentrations in the south west, in the Kinver Edge area, and Cannock Chase. A notable concentration remains in the Kinver Edge area, which is part of the rich heathland area around Kidderminster, although few post-1970 records occur from Cannock Chase. The acid grassland species recorded from the Midlands Plateau, including records from beyond Staffordshire, are listed in **Table 6** with the relevant extracts given below. Fourteen species have been recorded from the west of the Midlands Plateau Natural Area, of which two are apparently extinct. Of these *Silene conica* is definitely absent from the county.

The Flora of Staffordshire describes the sandy soils of Kinver Edge and Highgate Common as supporting a flora reminiscent of the Breckland, with species such as *Cerastium arvense*, *Echium vulgare*, *Teesdalia nudicaulis*, *Viola canina*, *Myosotis ramosissima* and *Thymus polytrichus* (Edees, 1972). In contrast, Cannock Chase and Hanchurch Hills are described as having a poor flora. The general impression of Cannock Chase is of a heathland which is much more transitional to the uplands than that of the Kinver Edge area. A special feature of the southern Staffordshire acid grasslands was *Erodium maritimum*, which occurred in both areas, but is apparently now extinct.

Habitat surveys

The Grassland Inventory includes many upland fringe sites in the Staffordshire Uplands, with very little recorded from the lowlands. The Heathland Inventory indicates that sizeable areas of heathland have survived in the Midlands Plateau, mainly in Cannock Chase but also at Kinver Edge.

Summary of consultations with Local Team Conservation Officers

A fair amount of acid grassland, dominated by U4, occurs in the north of the county, especially in the Potteries and Churnet Valley Natural Area but this is very upland in character. The Needwood and South Derbyshire Claylands Natural Area has very little acid grassland, but there are significant areas in the Midlands Plateau. Cannock Chase has much *Deschampsia flexuosa* grass heath (U2) in mosaic with heathland, and this grassland probably extends to over 100ha. In the Kinver Edge area, more parched acid grassland (U1) occurs but is probably less than 50ha in total. At Kinver Edge, a rotavated area with abundant *Erodium cicutarium* exists, and may form the rare Erodium-Teesdalia sub-community (U1c) (Chris Walker, pers. comm. 1996). Little of the lowland acid grassland is grazed.

36.4 Summary of resource

Extent and composition

If the upland fringe acid grassland is excluded, then the extent of acid grassland in Staffordshire probably occurs at the lower end of the 100-500ha class. Species-poor U2 grassland dominates, but species-rich U1 exists in the south east.

Conservation value

The Kinver Edge area is an integral part of the very important acid grasslands of the Kiddiminster area. Other, rather poorer, acid grasslands are an integral part of the extensive surviving heathland ecosystem of Cannock Chase.

36.5 Future requirements for survey and conservation

Survey

For acid grasslands the main regional priority is to survey and assess the condition of the Kidderminster/Kinver Edge area in Staffordshire and neighbouring counties. The Potteries and Churnet Valley is an area mentioned by Chris Walker (English Nature) as requiring survey, presumably for a general grassland survey which would include acid grassland.

Conservation

The Kidderminster/Kinver Edge is a clear priority for restoration and extension of acid grassland and associated heathland communities. Cannock Chase is under-grazed and the restoration of extensive pastoralism here would undoubtedly increase the diversity of the acid grasslands.

36.6 References

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Extract from Table 6 for Staffordshire: occurrence of plant species generally faithful to lowland acid grassland

County: South Staffordshire & adjacent areas	
Natural Area:	**43**
Grasses	
Corynephorus canescens	1
Other Vascular Plants	
Chamaemelum nobile	0
Dianthus deltoides	1
Erodium maritimum	0
Filigo minima	1
Hypochaeris glabra	1
Moenchia erecta	1
Ornithopus perpusillus	1
Potentilla argentea	1
Silene conica	1
Stellaria pallida	1
Teesdalia nudicaulis	1
Trifolium striatum	1
Vicia lathyroides	1
Total no. of species extant	**12**
Total no. of species extinct	**2**
Total no. of species recorded	**14**

43 = Midlands Plateau

1 = Recent record
0 = Apparently extinct

Staffordshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1972-91	Field, Common, Enc relic, Dift calc	Includes many upland fringe sites	32	649.0	6.2	NI		
Heathland Inventory		1983-93	Heath, Enc relict, Common, Field	Mostly in NA43, fragments beyond	52	2456.0			975.1	
Estimates, classes		1996		Chris Walker, English Nature				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Estimates, class	A		A	?		?		C				A										

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

37. Suffolk

37.1 Physical

Geology

The solid geology of Suffolk is relatively simple. Chalk occurs to the west, Pleistocene Crag deposits in the east, and Tertiary clays lie in a small area to the south east. These deposits are, however, mostly obscured by drift deposits of glacial or fluvio-glacial origin, including wind blown sand in Breckland. Other sand areas occur, including extensive areas along the coast in the Sandlings, and on river terraces, but much of the glacial material is dominated by boulder clay with Chalk (chalk till).

Soils

Much of Suffolk is dominated by stagnogley soils and calcareous pedosols developed in chalky till, but brown sands are locally dominant in Breckland and in the Sandlings. Smaller areas dominated by brown sands also occur on river terraces, especially along the River Waveney (**Map 1d**). In Breckland, complex mixtures of acidic soils with calcareous soils are characteristic, reflecting the depth of the sand deposits over the underlying Chalk. These mixtures can occur as small stripes and in polygonal patterns, which the fossilised remains of periglacial processes. Blown sand and sand dunes have historically made an to be important contribution to the ecology of the area. The Sandlings are also dominated by brown sands with associated podzols, but lack the calcareous sands that give such a special ecological character to Breckland.

37.2 Landscape history

19th Century

The 1800's (south) and 1830's (north) 1 inch OS maps show extensive unenclosed heathland in the Sandlings and even more extensive rabbit warrens and rough grazings in Breckland. A few commons are recorded along the south bank of the river Waveney. In both the Sandlings and Breckland, large areas of heathland survived into the 20th century. In Breckland, the area of grass heath in 1900 was nearly double that of 1824. It should be remembered that recolonisation of arable by grass heath has been much more of a integral feature of Breckland than on other heathlands. In the 1930's 34% of the then existing heath was 'new' heath (Lambley, 1994c). Since then, there have been large scale losses to agriculture and forestry in both Breckland and the Sandlings.

Current landscapes and Natural Areas

English Nature picks out the two main heathland areas as the Breckland Natural Area (NA46) and the Suffolk Coast and Heaths Natural Area (NA49). The land between is included within the East Anglian Plain (NA50), where the potential for acid grasslands is limited.

37.3 Existing information

Flora

The coincidence maps (**Map 2** to **4**) of lowland grassland species listed in **Table 1** show very high concentrations of records in Breckland, the Sandlings and along the River Waveney. Declines are evident from inspection of recent records, with the River Waveney suffering the greatest declines and Breckland the smallest declines.

The flora of Breckland was covered by Trist (1979) and the flora of the whole of Suffolk by Simpson (1982). The flora was analysed using the following units; and species from **Table 1** were listed in **Table 6** in these units (extract below).

- The Breckland Natural Area (46). The whole of the Natural Area, including Norfolk.
- The Suffolk Coast and Heaths Natural Area (49). The whole of the Natural Area.
- The river corridor along the River Waveney in both Suffolk and Norfolk in the East Anglian Plain (50) and the Broads (48) Natural Areas.

Breckland (all of NA46) is famed for its exceptionally rich grass heath flora, including species characteristic of dry acidic and base-rich soils, as well as sand dunes. It is the richest area in Britain for lowland acid grassland species with 24 species of the 33 species in **Table 1** extant and two apparently extinct. Many other species are present including large populations of *Carex arenaria*, rare species such as *Muscari neglecta*, *Silene otites* and *Veronica spicata* and many more widespread species. Trist (1979) and data on lower plant distibutions indicate that about 64 species listed on both **Tables 2** and **3** occur in Breckland in general, probably the highest total in Britain. *Holosteum umbellatum* has been long extinct and many surviving species are in a precarious situation, eg *Scleranthus perennis prostratus*. Rich *Cladonia* communities are present in the acid grasslands but the lichen flora of the calcicolous grass heaths is much richer in rare lichen species. The bryophyte flora of the acid grasslands is not very distinctive and the fungi flora is unknown (Lambley, 1994a). Within Breckland concentrations of species characteristic of disturbed acid sandy soils (**Maps 8-10**) still survive but these species are now rare beyond this area.

The Sandlings (NA49) is less famous for its acid grassland flora but collectively the area does support a rich acid grassland flora with 18 species extant and four apparently extinct. Beyond these areas, the extent of acid grassland is very limited but there is a respectable flora recorded from the River Waveney corridor, with sixteen species recently recorded and 4 apparent extinctions from the relevant 10km grid squares.

Fauna

Breckland harbours an important bird fauna including 10% of British Nightjars, 30% of British Woodlarks and over 50% of British Stone Curlews. It is one of the few areas where grass heaths are still sufficiently extensive to support Stone Curlew and although this species is increasingly using arable fields in which to nest, positive management of grass heath is resulting in a gradual return to this habitat.

Other species such as Woodlark and Nightjar depend more on the ephemeral appearance of acid grassland habitat types within clear felled conifer plantations rather than on grass heaths, from which they are nearly extinct, although Woodlark has recently expanded back on to the grass heaths.

Wheatear is increasingly scarce, whilst Stonechat and Whinchat numbers are extremely low. Ring Plover, abundant in rabbit warrens in the 19th century, is now confined to arable fields and gravel pits. Montagu and Hen Harriers were lost by the middle of this century. However, a positive feature is the colonisation of grass heaths by Curlew, which utilise longer grass than Stone Curlew and other species (Gibons *et al*, 1993 & Dolman, 1994).

The long term conservation of most species is thought to require the restoration of heavier grazing and greater physical disturbance. It is worth noting that many of these species (Woodlark, Nightjar, Ring Plover, Wheatear, Stonechat and Whinchat) currently have larger populations on acid grasslands in the New Forest than they do in Breckland.

The importance and status of the invertebrates of Breckland is summarised in the report *Ecological change in Breckland* (Haggett 1994, Duffey 1994 & Lambley 1994b). Numerous RDB (160) and Notable (154) species are recorded from Breckland habitats including grass heaths, fen, pingo ponds and ruderal communities. The grass heath represents an important habitat with 34.2% of the RDB species recorded from it. Interestingly, the taller Heather stands which have appeared since myxomatosis reduced rabbit populations have no particular spiders of interest. This is in contrast to the rich spider fauna of the grass heaths. For groups which there is sufficient data, such as the moths and butterflies, there is firm evidence to indicate the decline and extinction of many species of disturbed grass heath or early succession communities.

Habitat surveys

The Grassland Inventory records large areas of acid grassland and calcicolous and acid grassland mosaics in Breckland. Significant areas also occur in the Sandlings and some small areas in the East Anglian Plain, mainly along the River Wavney. The Heathland Inventory indicates a similar distribution. The majority of the sites recorded on both Inventories are either commons or the relics of large scale enclosure of commons, warrens or rough grazings.

Breckland NVC heathland survey (Smith, 1996 and Smith & James, 1995)

Most of the Suffolk Breckland acid grasslands and heaths on SSSIs are now covered by high quality Phase 2 surveys. These show U2 on ungrazed sites and mixtures of U1a, U1b, U1d, U1f, SD10 and SD11 on grazed sites. The vegetation patterns are often complicated with heath (H1), Bracken (U20) and calcicolous grassland entering into the mixture of vegetation types. Selected data from Lakenheath Warren SSSI is given in Volume I, Appendix 1, to illustrate the composition and characteristics of U2 and SD10 on grass heaths.

518ha of U1 and 175ha of *Deschampsia* grass heath (U2) have been recorded from the Breckland SSSIs. Uld and U1b were the most frequent types of U1 found, but an area of 49ha of the lichen-rich U1a was also recorded. The latter sub-community however, was surprisingly poor in lichen species compared to stands in Dungeness (Ferry *et al*, 1990) and Hampshire (Sanderson and Stanbury 1996). This may be part of the general degradation of the grass heath of the Breckland. Also, none of the Erodium-Teesdalia sub-community (U1c), was found, possibly another sign of the decline in the quality of the grass heaths.

A survey of unimproved grassland in Suffolk Wildlife sites (Casey et al, 1995)

Suffolk Wildlife Trust carried out NVC surveys of non-SSSI unimproved grasslands in 1994 and 1995. These surveys recorded a total of 106ha of dry acid grassland and transitions to acid grassland and Bracken, mainly in Breckland but also in the Sandlings and the edges of river valleys (River Waveney and River Stour). Of this total 18.6 ha is U20, of the remainder all but about 3 ha is U1 or U1 transitions. The non-U1 3.3 ha is Deschampsia flexuosa grassland (U2) and sand dune type SD10. Most U1 was not assigned to a sub-community (and may have been the Typical sub-community (U1b)) with U1a, U1b, U1d and U1e specifically recorded. An impresive range of Breckland RDB and nationally scarce species were recorded from some sites. An example is Icklingham Playing Fields with 1.1ha of mown U1 with *Silene otites, Crassula tillaea, Medicago minima, Medicago sativa falcata, Silene conica,* and *Vulpia ciliata ambigua.* A total of 176 sites were recorded in Suffolk as a whole. The predominant community type was mesotrophic grassland in 76% of sites, mires in 10%, calcicolous in 8% and acid grassland in 6%. Of the sites, 27 had RDB or nationally scarce species recorded from them. Six were non-grass heath sites and 21 were mainly Breckland grass heath sites. Of the latter 10 had U1 and/or SD10, 4 had CG7 and U1, 4 had CC7 and 3 were sites overgrown with

MG1. These results indicate the importance of both the Breckland grass heaths and the acid grassland within these sites.

Shingle surveys

The Suffolk coast has miles of shingle beaches, and as at Dungeness (Ferry, 1990), parched acid grassland (U1) is likely to be the main community of stabilised shingle grassland beyond the maritime edge, with U1d the main sub-community.

The maps in the NVC Volume 3 show lichen rich U1a was sampled along the Suffolk coast. These shingle grasslands can support a rich lowland acid grassland flora. The national shingle survey (Sneddon & Randall, 1994) is difficult to interpret but the site descriptions indicate that parched acid grasslands are widespread. Many of the synonymies suggested between the surveyed communities and the NVC (apparently derived by the use of computer comparisons) may not be correct.

Summary of consultations with Local Team Conservation Officers

The area of acid grassland in Suffolk is likely to be about 1000ha. It is estimated that about 600-700ha of parched acid grassland (U1) and about 200ha of *Deschampsia* grass heath (U2) are present. Most of this is found in Breckland and the Sandlings and a little by the River Waveney. Most is found within heathland or the relics of heathland enclosure. Data for the Sandlings SSSIs data indicates that there is about 330ha of acid grassland in this area.

The ecology and conservation of Breckland is summarised in Lambley (1994c). The Brecklands ESA has achieved grazing management on most remaining areas, with Countryside Stewardship funding restoration in the Sandlings. Some mowing is carried out on common land in the latter area, due to the difficulty of fencing for grazing purposes.

Cattle grazing has been carried out in Breckland but cattle were regarded as potentially able to damage Heather stands and have therefore been replaced by sheep. In Breckland, the experience is that sheep will only graze *Deschampsia flexuosa* if the stocking rate is sufficiently high. A major problem in obtaining suitable grazing stock is their local scarcity, due to the intensive and arable nature of agriculture in East Anglia.

37.4 Summary of resource

Extent and composition

The acid grassland resource is concentrated in Breckland although large areas are present in the Sandlings and a few significant patches occur elsewhere. The total resource probably somewhat exceeds 1000ha.

Breckland supports complex mixtures of grassland types and the more base-rich U1d is especially abundant. Outside of Breckland, U1b is likely to dominate. Shingle grassland along the Suffolk coast is also likely to hold floristically rich examples that are closely related to U1.

Conservation value

Breckland is the premier area for lowland acid grassland in England and the heathland habitat mosaic of which these grasslands are a part is clearly of international importance. Its condition has, however, given serious cause for concern (Lambley, 1994c) and many of the distinctive species are close to, or are, extinct. Lack of heavy grazing by both stock and rabbits is a major cause of these declines in species, but the legacy of past fragmentation is probably also of significance. The fact that with the exception of Stone Curlew, the acid grassland bird fauna is faring much better in the New Forest than in Breckland may be related to these factors. The Sandlings and nearby shingle structures are also of high, probably national, importance for acid grasslands, especially for the flora of these grasslands. Breckland and the Sandlings have rich invertebrate faunas, and Breckland, along with the New Forest, is the only area with a surviving lowland acid grassland bird fauna of significance. However, several of the species are now dependant on arable and forestry habitats.

37.5 Future requirements for survey and conservation

Survey

Phase 2 grassland surveys should cover any remaining unsurveyed areas of these important grasslands, for instance in the Sandlings. These surveys are valuable for monitoring and management purposes as well as to establish the composition of the resource.

Conservation

The restoration work that is possible under the ESA and the Countryside Stewardship Scheme needs to be carried out in both Breckland and the rest of the county. The long-term future of the habitats and species of Breckland and the Sandlings probably depends on the fragmentation of the heathlands being substantially reduced through conversion of arable and forestry land back to heathland. Green (1995) has produced a report for EN, setting out a plan for heathland re-creation in Breckland.

37.6 References

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Extract from Table 6 for Suffolk: occurrence of plant species generally faithful to lowland acid grassland

County: Suffolk			
Natural Areas:	**46**	**49**	**48/50**
Grasses			
Apera interrupta	1	1	0
Corynephorus canescens	1		0
Festuca longifolia	1		
Vulpia ciliata ambigua	1	1	1
Other Vascular Plants			
Chamaemelum nobile	0	0	0
Crassula tillaea	1	1	1
Dianthus deltoides	1	0	
Filago minima	1	1	1
Herniaria glabra	1		
Hypochaeris glabra	1	1	1
Medicago minima	1	1	0
Moenchia erecta	0	1	1
Ornithopus perpusillus	1	1	1
Potentilla argentea	1	1	1
Scleranthus perennis	1		
Silene conica	1	0	1
Stellaria pallida	1	1	1
Teesdalia nudicaulis	1	1	1
Thymus serpyllum	1		
Trifolium glomeratum	1	1	1
Trifolium ornithopodioides		1	1
Trifolium scabrum	1	1	1
Trifolium striatum	1	1	1
Trifolium subterraneum	1	1	
Trifolium suffocatum	1	1	1
Veronica verna	1	0	
Vicia lathyroides	1	1	1
Total no. of species extant	**24**	**18**	**16**
Total no. of species extinct	**2**	**4**	**4**
Total no. of species recorded	**26**	**22**	**20**

46 = Breckland (includes Norfolk)
49 =Suffolk Coast and Heaths
48/50 =River Wavney (includes Norfolk) in East Anglian Plain (50) and The Broads (48)

1 = Recent record
0 = Apparently extinct

Suffolk acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1983-93	Grass Heaths, Heaths, Enc Relics	Mainly Breckland & Sanderlings + By R. Wavney	49	2183.7	213.1	76.8		
Heathland Inventory		1983-91	Heaths, Grass Heaths, Enc Relics	Mainly Breckland & Sanderlings + By R. Wavney	73	8825.0			836.6	NI
Breckland Ph. 2 surveys		1995-6	Grassheaths, Enclosure relics	NVC surveys of Breckland acid grassland sites	12	1778.7		785.0		
Sandlings		1997	Heaths, Grass Heaths ?	EN SSSI data for Sandlings estimate	13			310.5		
Suffolk Wildlife Sites		1994-5	Mainly enclosure relics	NVC surveys of non-SSSIs (including transitions with other habitats)	37			106.0		
Estimates hectares		1996	As above	Anne Brenchley, EN				1000-5000		
Estimates classes		1996		Anne Brenchley, EN				E		

Survey Name	U1	U1a	U1d	U1c	U1b	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Breckland	517.7	48.7	169.3		266.0	33.7		175.2	175.2											77.7	14.4	
Sandlings	+							+														
* Wildlife Sites	63.7	2	7.5		5.3	+		0.5														
Estimates ha	7/800							200														
Estimates class	D	B	C		C	B		C	C											B	A	

* Pure communities, not transitions or mosaics

Key

Column headings

GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland

H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates

A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha

F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

38. Surrey

38.1 Physical

Geology

Surrey is divided by the Chalk hills of the North Downs, with Lower Cretaceous sands and clays to the south and Tertiary deposits to the north. The Lower Cretaceous rocks include a wide band of Lower Greensand associated with extensive heathlands. The Tertiary deposits to the north include part of the largest outcrop of Bagshot and Barton Beds in the Thames Basin and this is also associated with large heathlands. On the dip slope of the North Downs there are also outliers of the sandy Thanet Beds which also support heathland. River terrace gravels are also significant in the Thames Basin.

Soils

Extensive areas of the Lower Greensands and the Bagshot and Barton Beds north of the Downs are dominated by podzols. A small patch of brown sand is recorded on the Downs at Headley (**Map 1b**).

38.2 Landscape history

19th Century

The 1810's 1 inch OS maps record immense areas of heathland commons both on the Greensand and in the Thames Basin. Rough grazings, including heathland were also abundant on the dip slope of the Downs.

Current landscapes and Natural Areas

The Natural areas reflect the geology of the county, with the Low Weald and Pevensey Natural Area (NA73) dominated by the Weald Clay to the south, having the least potential for acid grassland. Other areas include the Wealden Greensand Natural Area (NA70), the London Basin Natural Area (NA66) and the North Downs Natural Area (NA69). All have suffered serious losses of heathland to enclosure, colonisation or planting of woodland or in the case of the first two Areas, urban development.

38.3 Existing information

Flora

The coincidence maps (**Map 2-4**) of lowland acid grassland species listed in **Table 1** show very high concentrations recorded from areas both north and south of the Downs. Declines are evident from inspection of recent records, with the decline in the Thames Basin being much more dramatic than on the Greensand. Concentrations of species typical of disturbed acid sandy soils are recorded north and south of the Downs (**Maps 5-7**) and concentrations of ephemeral pond species are recorded north of the downs (**Maps 8-10**). Declines have also occurred in these species, but some species have been recorded since 1970.

The Flora of Surrey (Lousley, 1976) and its supplement (Leslie, 1987) were consulted. The species recorded from the three Natural Areas involved are listed in **Table 6**, an extract of which is shown below. The maps in Lousley (1976) show acid grassland species to be most frequent in the Greensand heathland areas, with species such as *Carex arenaria*, *Trifolium scabrum* and *Vulpia ciliata ambigua* confined to the Greensand, where the sands tend to be coarser and most freely draining, compared to other acid soils in Surrey.

Other species, eg *Vicia lathyroides* and *Trifolium striatum* are common on the Greensand, rare on the Bagshot and Barton Beds heathlands but are more frequent on lower terrace river gravels to the north. Other species of interest include *Scilla autumnalis,* which was still recorded at Hurst Park in 1983 (Leslie, 1987), *Scleranthus annuus polycarpos, Cerastium diffusum* and *Cerastium arvense. Agrostis curtisii* is locally abundant in the Thames Valley heathlands but is absent from the Greensand.

Fauna

The Hampshire/Surrey border population of Wood Lark makes some use of mown acid grassland (Clark, 1993).

Habitat surveys

The Grassland Inventory recognises the presence of acid grassland within the heathlands but does not give any areas. The Heathland Inventory records the extensive survival of heathland north and south of the Downs as well as the survival of Headley Down on the dip slope of the Downs.

Unimproved neutral and acidic grassland in Surrey (Steven, 1990a)

There is one published report on a Phase 2 grassland survey which covered both neutral and acid grassland. Only a few acid grassland sites were sampled. Two of the sites surveyed contained acid grassland: Reigate Heath SSSI, on the Greensand, and Staines Moor SSSI on the Thames flood plain. Reigate Heath is mostly a golf course but species rich stands of parched acid grassland referable to the Typical sub-community (U1b) occur around cricket and football pitches. Species present include *Plantago coronopus, Ornithopus perpusillus, Myosotis ramosissima, Trifolium striatum, Trifolium ornithopodioides, Scleranthus annuus, Cynodon dactylon, Silene gallica, Moenchia erecta* and *Botrychium lunaria.*

A re-survey in 1997 (Sanderson, N.A., 1997c) confirmed the site was still of interest with species-rich U1b surviving on the mown cricket and football pitches and the edge of the golf course fairways. On the football pitch, enriched patches (MG7) supported one of Surreys few surviving colonies of *Chamaemelum nobile.* A total of six acid grassland species (**Table 1**) and 10 locally characteristic species (**Table 2**) were recorded, giving a total of 16 dry acid grassland indicator species (**Table 8**).

Staines Moor SSSI is a heavily grazed, flood plain, common with parched acid grassland (U1) on the drier ground passing into Lolium-Cyonosurus grassland (MG6) on damper ground. The U1 appears to belong to the Anthoxanthum-Lotus sub-community (U1d). *Moenchia erecta* has been recorded.

Three other sites are, rather unconvincingly, described as having Festuca-Agrostis-Galium Grassland (U4). The vegetation described is referred to in all cases as having patches of *Molinia* present, and at least some of it is clearly Molinia-Potentilla grassland (M25b). Some grassland approximating to U4 is, however, clearly present.

Summary of consultations with Local Team Conservation Officers

The Greensand heathlands contain some Deschampsia flexuosa grassland (U2) which is associated with die-off of Heather, a feature absent from the Greensand heaths of Hampshire and Sussex. Species rich parched acid grasslands (U1) are widespread, although much reduced since Lousley's time. They are usually found on disturbed and somewhat enriched soils rather than the podzols found under the U2 grasslands and the heaths. The typical sub-community (U1b) appears to dominate, as in Hampshire, whilst U1e is rare, and not dominant as stated by Rodwell (1992) in the NVC.

Carex arenaria communities are present, with well developed loose sand communities around Frensham Pond, where *Vulpia ciliata* occurs. U1c and U1d are likely also to be present. Good examples occur in the main heathland blocks, especially in the Frensham Pond and Thursley Common areas, but interesting stands extend further west on smaller commons. These include Puttenham Heath (SU9447) St Martha's Hill (TQ0248) and Blackheath(TQ0346), and it is possible that *Lotus angustissimus* may be native here (Dr Rose, pers. comm. 1996). Small patches of grassland occur at Deerleap Wood (TQ1148) and in the far west, Reigate Heath (TQ5024). Several of these sites are golf courses.

As well as these heathland sites, patches of U1 exist on sandy alluvium in the flood plain of the River Wey, but these are not species-rich (Peter Tinning, pers. comm. 1996). Dr Rose considers that there is approximately 50ha of U1 grassland, and at least 100ha of U2 grassland, possibly more, on the Greensand. Greensand heaths are generally considered important for a flora and fauna that reflects their hot, dry character.

The heathlands north of the Downs are considered to be more degraded, with both the heath and the grassland in poor condition (Dr. Rose, pers. comm. 1996). The spread of U2 at the expense of heath is much worse than on the Greensand. There may be some mown areas in the military ranges and Chobham Common is better with large areas of Agrostis curtisii grassland (U3). Some golf courses may be of interest. Village greens and small fields often support acid grassland but the latter are mostly overgrown and the former likely to be semi-improved (Peter Tinning, pers. comm. 1996). It is estimated that between 50-100ha of U1, less than 50ha of U3 and 100-500ha of U2 exist in the heathlands north of the Downs (Dr. Rose, pers. comm. 1996). Headley Heath on the Downs has some interesting acid grassland.

Grazing and other restoration work is being experimentally introduced, and some acid grasslands on golf courses and public open spaces are mown.

38.4 Summary of resource

Extent and composition

There are approximately 500 to 1,000ha of acid grassland in Surrey, with over 500ha of U2, over 100ha of U1 and less than 50ha of U3. The richest grasslands for declining and characteristic plants are those on the Greensand but Lousley (1976) indicates that the gravel terraces near the Thames may also be of interest.

Conservation value

The heathlands and associated acid grasslands of the western Greensands are of exceptional importance. These areas represent a transition between the damper heathlands of the New Forest and the more Continental heathlands of Breckland, but have a distinctive character of their own. The overall heathland ecosystem of the Greensand heathlands are certainly of international importance and the acid grasslands are of at least national importance in their own right.

The heathlands to the north are rather less outstanding. They resemble the New Forest, and although much more degraded, are still of great ecological importance.

38.5 Future requirements for survey and conservation

Survey

A Phase 2 survey of the acid grassland on the Greensand is a high priority. The current condition of the acid grassland flora of the gravel terraces near the Thames should also be investigated.

Conservation

The restoration of extensive grazing to the Surrey heathlands will be the most effective long-term form of conservation. The Greensand has a high potential for the restoration of acid grassland from cultivated land.

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Extract from Table 6 for Surrey: occurrence of plant species generally faithful to lowland acid grassland

County: Surrey			
Natural Areas:	70	66	69
Grasses			
Vulpia ciliata ambigua	1		
Other Vascular Plants			
Chamaemelum nobile	1	1	1
Crassula tillaea		0	
Dianthus deltoides	1	1	
Filago minima	1	1	1
Hypochaeris glabra	1	1	
Moenchia erecta	1	1	
Ornithopus perpusillus	1	1	1
Potentilla argentea	1	1	
Sagina subulata	1	0	
Stellaria pallida	1		
Teesdalia nudicaulis	1	1	
Trifolium ornithopodioides	1	1	1
Trifolium scabrum	1	1	
Trifolium striatum	1	1	1
Trifolium subterraneum	1	1	1
Vicia lathyroides	1	1	
Viola lactea		0	
Total no. of species extant	**16**	**13**	**6**
Total no. of species extinct	**0**	**3**	**0**
Total no. of species recorded	**16**	**16**	**6**

70 = Wealden Greensand
66 = London Basin
69 = North Downs

1 = Recent record
0 = Apparently extinct

Surrey acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1986-93	Heath, Enc relic, Flood plain, Common	Mainly in heathlands in NA66 & 70.	15	6235.7	8.5	2.0		
Heathland Inventory		1982-87	Heath, Enc relic	Mainly in NA66 & 70.	59	11778.0			2841.4	
Steven (1990)		1990	Common, Flood plain, Heath	Phase 2 survey report, no areas given	5			NI		
Estimates NA46, classes		1996		Dr Francis Rose, Greensand				C		
Estimates NA38, classes		1996		Dr Francis Rose, Thames Basin heaths				C		
Estimates, classes		1996		Dr Francis Rose, county estimate				D		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Steven (1990)	+		+		+							+										
Estimates NA70	A		+	?	+	+		B												?	?	
Estimates NA66	B							C			A	A										
Estimates, class	C		+		+	+		D			A	A								?	?	

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

39. Sussex (East and West Sussex)

39.1 Physical

Geology

The counties of East and West Sussex are dominated by the southern half of the Wealden anticline. In the centre of the anticline the clays, sands and sandstones of the Lower Cretaceous Hastings Beds underlie the High Weald. This is surrounded by the low-lying Weald Clays, with the Lower Greensand, Gault Clay and Upper Greensand forming narrow bands below the Chalk scarp. The Lower Greensand contain acidic sands and are widest to the west of the county.

The south is dominated by the Chalk scarp of the South Downs. The small areas of Tertiary sands and clays on the south eastern coastal plain area obscured by terrace deposits with much loess. The coast includes dune and shingle complexes, with significant shingle beaches at Rye Harbour (TQ91), the Crumbles, Pevensey (TQ6401-6402) and Pagham Harbour (SZ8796).

Soils

In the High Weald the most extensive areas of acid soils have developed on the Ashdown Sands, where podzolic soils that are reasonably water retentive dominate in the Ashdown Forest area. Soils on the Lower Greensand are generally much more freely draining with podzolic soils dominant on the Folkestone Beds & the Hythe Beds, and brown sands on the Sandgate and Bargate Beds. In other areas, dry acid soils are more limited in extent and are often associated with drift deposits. Reasonably large areas of shallow rankers are developed on some of the shingle beaches (**Map 1b**).

39.2 Landscape history

19th Century

In the early 19th century the Lower Greensand outcrops west of Storrington supported many heathland commons. Heathland commons with pasture woodlands were widespread in the High Weald.

Current landscapes and Natural Areas

In the High Weald Natural Area (NA72), with the exception of the extensive heathland of Ashdown Forest and a few other fragments, most of the heathland in this Area has been lost, with the remaining areas ungrazed or under grazed, and woodland is the predominant semi-natural vegetation.

The Low Weald and Pevensey Natural Area (NA73) is dominated by heavy soils with extensive areas of woodland. The heathlands of the Lower Greensand within the Wealden Greensand Natural Area (NA70) have survived to a much greater degree, with extensive, if ungrazed, heaths and acid grassland still present on the Folkstone Beds. Those on the Hythe Beds have mostly been replaced by woodland and plantation.

The South Downs Natural Area (NA74) still has important areas of unimproved calcicolous grassland on the scarps but little grassland survives on the less steep dip slopes, whilst the South Coast Plain and Hampshire Lowlands Natural Area (NA75) in Sussex is dominated by intensive farmland. The latter Area includes shingle beaches as does the Low Weald (NA73) and the Romney Marsh Area Natural Area (NA71), which has large areas of stable shingle beach.

39.3 Existing information

Flora

The coincidence maps (**Map 2-4**) of lowland acid grassland species listed in **Table 1** show high concentrations recorded from the Greensand and from the coast, whilst the High Weald has a markedly lower concentration of these species. Declines are evident from inspection of the recent records, but areas of interest still survive on the Greensand and along the coast.

Useful sources on the acid grassland flora of Sussex are the *Sussex plant atlas* (Hall 1980, Briggs 1990) and *The habitats and vegetation of Sussex* (Rose 1995a), which gives a more up-to-date account. The distributions of *Galium saxatile* and *Rumex acetosella* given in Hall (1980) indicate that there is widespread potential for acid grassland in the High Weald (NA72) and the Greensand (NA70) with scattered records across the cap of the South Downs (NA74). Both these species are scarce in the South Coast Plain (NA75) and the Low Weald (NA73).

A single inland area is picked out as being of special significance; the Folkstone Bed heathlands. Here on the Lower Greensand between Iping Common (SU8421) and Sullington Warren (TQ0914) there are frequent records of specialist acid grassland species including *Agrostis curtisii, Moenchia erecta, Cerastium arvense, Botrychium lunaria, Carex arenaria, Hypochaeris glabra* and *Teesdalia nudicaulis.* Sites mentioned include Midhurst Common (SU8720), Heyshott Common (SU9019), Coates Common (TQ0017), Wiggonholt Common (TQ0616), Parham Park (TQ0514), Hurston Warren (TQ0716) and Sullington Warren (TQ0914).

On the Hythe beds only Petworth Park (SU2296) has any records of acid grassland species. Rose (1995a) records that many of the sites have deteriorated in recent years due to lack of sufficient grazing, partly because of the decline of rabbit grazing. A total of eleven lowland acid species have been recorded in this area but one, *Sagina subulata,* has not been recorded recently (**Table 6** and extract below).

The High Weald is less rich in acid grassland species, with seven species recorded recently and two possible extinctions (**Table 6** and extract below). The area does have some species of damper soils, including *Viola lactea* and *Cicendia filiformis,* but few specific sites are mentioned in the literature other than Chailey Common and Ashdown Forest.

The sites with the highest number of records of acid grassland species listed in **Table 1** are, however, grasslands that have developed on stabilised shingle at Rye Harbour (TQ91), the Crumbles, Pevensey (TQ6401-6402) and Pagham Harbour (SZ8796). The former includes recent records for thirteen species (**Table 6** and extract below) with one possible extinction. The description in Rose (1995a) of the Crumbles grassland indicates that this is Festuca-Agrostis-Rumex Grassland Cornicularia-Cladonia sub-community (U1a), and that this community also occurs at Pagham Harbour where the RDB *Petrorhagia nabteuillii* is frequent.

Fauna

One acid grassland site on the Lower Greensand supports the only native surviving colony of the Field Cricket (*Gryllus campestris*) in the UK. Wheatear, once abundant on the Downs, now only regularly breeds on shingle areas in Rye Harbour (which include parched acid grassland). Here most pairs nest in artificial burrows (James, 1996).

Habitat surveys

The East and West Sussex County Grassland Inventories indicate that little survey work has been carried out on acid grasslands by English Nature. None of the known sites of high interest indicated by the review of floristic data have been surveyed and sites in the Inventories appear to have been recorded as part of surveys that were directed at neutral and chalk grasslands. The Chalk grassland dataset contains 10.4ha of U4b, including mosaics and 0.25 of U1d in West Sussex, and in East Sussex 9.3ha of U4a, 7ha of U4b and 1ha of U1. From the East Sussex report on Chalk grassland (Steven and Muggeridge, 1992), it seems that U4 may have been mis-identified in some cases; some stands described as U4 had *Rumex acetosella* noted as abundant and hence are therefore more likely to be stands of U1, probably U1e. Selected data from Burnthouse Down is given in Volume I, Appendix 1, to illustrate U4 on drift occurring over Chalk.

Petworth Park (Sanderson, 1994b)

During a lichen survey of Petworth, a large landscape park, the grassland was found to include approximately 150ha of acid grassland. It was referable to Festuca-Agrostis-Rumex Grassland Potentilla-Galium sub-community (U1e). The stand is probably the largest acid grassland in Sussex but the U1e is species-poor, as is typical of this type of acid grassland, although *Chamaemelum nobile* was seen and *Moenchia erecta* has been recorded. The deer grazed pasture was typically rather matted and coarse and would probably benefit from summer cattle grazing.

Biological survey of common land (Finch et al 1994 & Finch & Aitchison 1994)

The biological survey of common land (Finch *et al* 1994 & Finch & Aitchison 1994) records 40ha of unimproved acidic grassland in East Sussex and 31ha in West Sussex. This total includes grasslands with *Arrhenatherum, Molinia, Deschampsia cespitosa* and *Juncus* dominant, but excludes acid grassland with some Heather, so has little relevance to the current report. Semi-improved acid grassland is defined as grasslands containing *Lolium* so are also beyond the scope of this review.

Coastal shingle (Sneddon & Randall 1994; Williams & Cooke 1993)

It is clear from Rose (1995a) that the stabilised shingle grassland in Sussex is similar to that at Dungeness described in Ferry *et al* (1990). The grassland is predominately comprised of communities closest to parched acid grassland (U1) but with maritime grasslands (MC5 & MC8) present where an influence of salt spray occurs.

The Shingle Survey of Great Britain (Sneddon & Randall, 1994) examined three sites and Williams & Cooke (1993) examined all the non-SSSI shingle on the Sussex coast. The latter survey noted that the best site examined, The Crumbles, included similar stabilised grassland to Dungeness. Quadrat data from this survey indicates that U1f is present. Quadrat data also indicates the presence of U1d at Pagham Harbour.

The data in Sneddon & Randall (1994) is difficult to interpret. From their descriptions the stable shingle grassland of Rye Harbour includes U1f and U1d. Data from the former is actually assigned to U1f but data on the latter is assigned to Ammophila-Festuca Semi-fixed Dune (SD7) in spite of the absence of *Ammophila*.

Summary of consultations with Local Team Conservation Officers

The coastal shingle grasslands are floristically rich and important. It is estimated that approximately 100ha of parched acid grassland (U1) occurs along the coast, with much of it lichen-rich U1a, U1d and U1f (Dr. Rose, pers. comm. 1996). The largest site is Rye Harbour with other sites of interest including Pagham where a lichen flora is present that includes *Usnea articulata*, *Cladonia foliacea* and *Ramalina farinacea* .

Inland the most floristically rich grasslands are on the Lower Greensand. These grasslands are mostly associated with heathland although rich areas also occur in parklands. The ancient deer park of Parham Park includes an area of U1b grassland, with abundant *Carex arenaria*, and recently a rich area of U1b has been found in a fragment of the landscape park of Cowdray Park (SU913 222), with *Teesdalia*, *Viola canina* and *Moenchia erecta* present.

The heathland areas have suffered a drastic decline of quality in recent decades but Hurston Warren golf course is still good in localised areas as a result of mowing. Beyond the main area in the west, a little U1 survives on the Greensand at Lodge Hill, Ditchling (TQ322157). Beyond the atypical Petworth Park with its c150ha of U1e, less than 50ha of U1 probably survives on the Greensand. This is most likely to be U1b although U1d may also be present. A little *Agrostis curtisii* is present on Iping Common but does not form an area of U3. *Deschampsia flexuosa* invasion is scarce and the area of U2 is less than that of U1. The River Arun draining from the Lower Greensand has patches of U1 on the flood plain, but these are not species-rich.

The Low Weald has very little acid grassland but one site examined by the author, Henfield Common (TQ2215), has an area of reasonably well-developed U4. This represents an in interesting repeat of observations from other south eastern counties, with U4 confined to well drained acid clay soils.

The High Weald has acid grassland associated with heathland at Ashdown Forest and the Chailey commons, and a few fragments exist elsewhere. Ashdown Forest is currently under-grazed and its dry acid grasslands are in poor condition. Much of the area is on wet impervious soils but the ridge tops do have dry grasslands. Deschampsia flexuosa grassland (U2), often with much *Molinia*, dominates, whilst rank *Festuca-Agrostis* grasslands occur on road verges and elsewhere. Where identifiable, these stands are apparently U1f. Other fragments and the Chailey commons have mixtures of U2 and U1e.

Grazing has been experimentally reintroduced into a large enclosure in Ashdown Forest but this does not include any dry grassland. Few coastal or heathland acid grasslands are grazed but restoration projects have begun on the heathlands and rabbit grazing is adequate on many coastal sites.

39.4 Summary of resource

Extent and composition

There is probably just over 500ha of acid grassland in Sussex, with parched acid grassland (U1) dominant. Species-rich parched acid grassland (U1a, U1b, U1d & U1f) is confined to coastal shingle structures and the heathlands and parklands of the Lower Greensand. Less rich grassland is a significant part of the habitat mosaics of the High Weald heathlands, with fragments elsewhere.

Conservation value

The best coastal and the Greensand parched acid grasslands are of high conservation value. The Greensand grasslands are best regarded as an integral part of the heathland complex extending from Surrey to Sussex, through Hampshire. The grasslands here are a significant part of one of the most important lowland heathland areas in England.

39.5 Future requirements for survey and conservation

Survey

The surveying of the Lower Greensand acid grasslands at a Phase 2 level along with those of Surrey is a very high national priority.

Conservation

The restoration of extensive grazing to the Lower Greensand heaths is a priority; the decline of rabbit grazing has reduced the extent and quality of the grasslands here. Grazing management is already planned for Iping Common and other areas. On some smaller sites, mowing may be enough to encourage adequate rabbit grazing. On other sites, where the grassland is found on road verges, any fencing schemes should include these areas. Acid grassland is likely to be relatively easy to create from arable reversion on the Lower Greensand.

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Extract from Table 6 for Sussex: occurrence of plant species generally faithful to lowland acid grassland

County: Sussex (East and West)			
Natural Areas:	70	72	71
Chamaemelum nobile	1	1	
Filago minima	1	1	
Hypochaeris glabra	1		1
Medicago minima			1
Moenchia erecta	1	1	1
Ornithopus perpusillus	1	1	1
Potentilla argentea	1		0
Sagina subulata	0	0	
Stellaria pallida		1	1
Teesdalia nudicaulis	1	0	1
Trifolium glomeratum			1
Trifolium ornithopodioides	1		1
Trifolium scabrum	1		1
Trifolium striatum	1		1
Trifolium subterraneum	1	1	1
Trifolium suffocatum			1
Vicia lathyroides			1
Viola lactea		1	
Total no. of species extant	**11**	**7**	**13**
Total no. of species extinct	**1**	**2**	**1**
Total no. of species recorded	**12**	**9**	**14**

70 =Wealden Greensand
72 = High Weald
71 = Romney Marshes

1 = Recent record
0 = Apparently extinct

Sussex acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
WS Grassland Inventory		1987-62	Calcicolous, Enc. relic, Meadow	Heathland & shingle areas not covered	11	292.5	153.9	7.2		
ES Grassland Inventory		1989-91	Calcicolous, Common, Meadow	Heathland & shingle areas not covered	6	354.3	153.0	NI		
Grassland: Sussex Total					17	646.8	306.9	7.2		
WS Heathland Inventory		1981-92	Heathland and Enclosure relic	Most dry heath on Lower Greensand	45	2240.0			310.3	
ES Heathland Inventory		1982-89	Heathland and Enclosure relic	Majority of dry heath in Ashdown forest	14	6016.0			454.5	
Heathland: Sussex Total					76	8902.8			764.8	
Petworth Park BSA	SU965230	1994	Parkland	Notes on grassland in lichen survey	1	250.0	235.0	156.0		
EN Phase 2 W Sussex		198892		Allwright, (1988) & Steven (1992)				26.0		
EN Phase 2 E Sussex		1990,92		Steven & Muggeridge1992 & Steven 1990b				23.0		
Estimates, classes		1996		Dr Francis Rose				C		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
WS Grass Inv.																						
ES Grass Inv.																						
Grass Totals																						
WS Heath Inv.																						
ES Heath Inv.																						
Heath Totals																						
Petworth Park	156.0					156.0																
EN Phase 2 W Sussex	7.0				0.25							19.0		10.4								
EN Phase 2 E Sussex	1.0											22.0	9.3	7								
Estimates, class	C	A	A		A	C	A	B	B			A	A	A								

Key

GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland

Column headings

H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates

A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

40. Warwickshire

40.1 Physical

Geology

The south of the county includes Jurassic Lias clays, and Permian and Triassic sandstones and mudstones dominate the rest of the county. In the north west, small areas of Coal Measures occur.

Soils

The soil map does not record any areas dominated by acid soils. (**Map 1c**)

40.2 Landscape history

19th Century

The 1830's 1 inch OS maps show a largely enclosed landscape.

Current landscapes and Natural Areas

In the north the county includes part of the Midlands Plateau Natural Area (NA43) and in the south, part of the Cotswolds (NA55). Between these Areas are the Severn and Avon Vales Natural Area (NA56) and the Midland Clay Pastures (NA44).

40.3 Existing information

Flora

The coincidence maps (**Maps 2-4**) of lowland acid grassland species listed in **Table 1** show a slight concentration in the Severn Valley, but there are few recent records from this area. The best square shown is SP26. The area has suffered a very marked decline in recent decades. A list of species found in the Severn Valley are listed in **Table 6** and the relevant extract is shown below.

Habitat surveys

The Grassland and Heathland Inventories records a few areas of acid grassland and heathland, mainly in the Midlands Plateau Natural Area. Nothing has been recorded in SP26.

Summary of consultations with Local Team Conservation Officers

A few fragments of acid grassland occur in the north on Coal Measure outcrops, but the area is very limited. The Midlands Clay Pastures may include some areas of U1.

40.4 Summary of resource

Extent and composition

Little is known about the composition, location or interest of acid grassland in the county.

Conservation value

The limited amount of acid grassland that is known is unlikely to be of more than local interest.

40.5 Future requirements for survey and conservation

Survey

There are no priorities for Phase 2 survey but the possible presence of acid grassland in SP26 could be investigated.

Conservation

No high priorities have emerged.

Extract from Table 6 for Warwickshire: occurrence of plant species generally faithful to lowland acid grassland

County: Warwickshire	
Natural Area:	**56**
Chamaemelum nobile	0
Hypochaeris glabra	0
Moenchia erecta	0
Ornithopus perpusillus	1
Potentilla argentea	1
Teesdalia nudicaulis	0
Trifolium ornithopodioides	0
Trifolium striatum	0
Trifolium subterraneum	1
Total no. of species extant	**3**
Total no. of species extinct	**6**
Total no. of species recorded	**9**

56 = Severn and Avon Vales

1 = Recent record
0 = Apparently extinct

Warwickshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1979-86	Field, Common	Few sites recorded	5	67.5	3.2	3.2		
Heathland Inventory		1982-93	Common, Enclosure relic	Mainly in or near NA43	9	266.0			16.1	
Estimates, classes		1996		Chris Walker, English Nature				A		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Estimates, class	?																					

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

41. West Midlands

41.1 Physical

Geology

The county is underlain by Permian and Triassic sandstones and mudstones which surround large outcrops of Coal Measures.

Soils

Much of the county is heavily urbanised and lacks soil information. Brown sands and podzols are dominant in and near Sutton Park (**Map 1c**).

41.2 Landscape history

19th Century

The 1830's 1 inch OS maps show Sutton Park and its associated heathland, plus enclosed common land to the south west.

Current landscapes and Natural Areas

The county lies within the Midlands Plateau Natural Area (NA43) Since the 1830's the West Midlands has become increasingly urbanised but some heathland survives as parkland.

41.3 Existing information

Flora

The coincidence maps (**Maps 2-4**) of lowland acid grassland species listed in **Table 1** show that some species have been recorded in the past but there are few recent records.

Habitat surveys

The Grassland and Heathland Inventories record large areas of heath and acid grassland in Sutton Park and small fragments elsewhere.

Summary of consultations with Local Team Conservation Officers

Over 50ha of U2, U4 and U5 occurs in the medieval deer park of Sutton Park. The grassland grades from wetter Molinia areas through U5 *Nardus* grassland on gentle slopes to U4 *Agrostis-Festuca* grassland in drier areas. The U2 occurs in less intensively grazed areas. Only fragments of acid grassland survive beyond Sutton Park.

41.4 Summary of resource

Extent and composition

The only sizeable area of acid grassland is in Sutton Park.

Conservation value

Sutton Park is a remarkable survival of a complex of heathland, grassland, wetland and pasture woodland in an urban context, and it has been designated as a National Nature Reserve.

41.5 Future requirements for survey and conservation

Survey

No obvious priorities for survey.

Conservation

Parts of Sutton Park may be under-grazed and the habitat quality would be improved by the restoration of grazing by livestock.

West Midlands acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1986-91	Park, Enclosure relic, Field	Large area in Sutton Park	5	994.3	72.0	72.0		
Heathland Inventory		1989-91	Park, Enclosure relic, Waste	Large area in Sutton Park	21	1099.0			289.4	
Estimates, classes		1996		Chris Walker, English Nature				B		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Estimates, class								A				+						A				

Key

Column headings

GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates

A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

42. West Yorkshire

42.1 Physical

Geology

The Pennines to the west and north of the county are composed of Millstone Grit and a wide exposure of the Coal Measures. The eastern edge of the county includes part of a narrow band of Magnesian Limestone.

Soils

To the west, the Pennines have upland soils, and surface water gleys dominate over the Coal Measures. To the east, beyond Doncaster, the recent deposits include areas of brown sands (**Map 1e**).

42.2 Landscape history

19th Century

The 1840's 1 inch OS map shows a largely enclosed lowland landscape.

Current landscapes and Natural Areas

The Natural Areas of the region closely follow the geology. The uplands to the west are part of the Southern Pennines Natural Area (NA14) and the Dark Peak Natural Area (NA25). The centre of the county is occupied by the Coal Measures Natural Area (NA24), and the Southern Magnesian Limestone Natural Area (NA23) lies to the east. The Coal Measures Area has become highly urbanised.

42.3 Existing information

Flora

The coincidence maps (**Maps 2-4**) of lowland acid grassland species listed in **Table 1** show that a few species have been recorded from the Coal Measures. The West Yorkshire Atlas (Lavin & Wilmore, 1994) records seven acid grassland species, three of which are extinct (**Table 6** and relevant data extracted below). These include *Chamaemelum nobile* which has not been seen as a native since 1775. The extant species are all described as rare, and have been seen only a few times, either on waste land or sandy acid grassland and heath.

Habitat surveys

The Grassland Inventory includes 47 sites from which acid grassland has been recorded, just over half of which are records from fields and waste land in the lowland Coal Measures. The Heathland Inventory records heath in two woodland sites.

Three of the West Yorkshire Districts, Kirklees, Calderdale and Bradford, have been surveyed for enclosed grasslands. The Humber to Pennines Local Team provided a summary of the areas surveyed. The combined figures for acid grassland found are: U1, 14.2ha; U2, 0.6ha and U4, 17.9ha giving a total of 32.7ha of acid grassland. The total given for surveyed acid grassland is the much higher figure of 89.4ha. It is not clear what were communities in the unclassified acid grasslands.

The Atlas includes an account of the vegetation of the area by Rodwell (1994). The upland moors include extensive areas of Festuca-Agrostis-Galium grassland (U4) and Nardus-Galium grassland (U5), especially when heavily grazed by sheep.

On the lower ground, small areas of dry acid grassland can be found among heath and developing woodland. These grasslands usually mark out exposures of Coal Measure sandstones and include stretches of U4 and Deschampsia flexuosa grassland (U2) and, locally, in droughty soils, patches of parched acid grassland (Festuca-Agrostis-Rumex grassland (U1).

The U1 grasslands can be found on soil heaps of bell pits and ancient coal mines. There is an attractive mosaic of heath, acid grassland and scrub at Seckar Wood near Wakefield. Lists of associated species in the flora indicate that Galium-Potentilla sub-community (U1e) is the main sub-community present.

Summary of consultations with Local Team Conservation Officers

Three of the five West Yorkshire Districts have been surveyed for enclosed grasslands, and cover the West Yorkshire part of the Southern Pennines Natural Area and a sizeable amount of the Coal Measures Natural Area. Extrapolating from the existing information it is considered that the current resource of lowland acid grassland is certainly over 50ha, possibly over 100ha but unlikely to be over 200ha. U1 and U4 are of similar percentage (contradicting Rodwell (1994)), whilst there is a much smaller area of U2. U5 and U20 occur but their extent is not known.

In the South Pennines, upland fringe acid grassland occurring below 300m is important as a feeding ground for internationally important populations of waders breeding on the moors, with both seed and invertebrates utilised. In the Coal Measure Natural Area, spoil tips, urban commons, mosaics of heathland and parkland contain acid grassland, that comprises a mix of U2, U4, U5, U20 with H8, H9 & H12.

42.4 Summary of resource

Extent and composition

The lowland acid grassland resource of West Yorkshire consists of small, fragmented, sites with a very limited flora and a particularly reduced lowland element. The enclosed grasslands of the South Pennines are ecologically part of the wider ecosystem of the Pennine Moors and are clearly best regarded as upland fringe grassland. From the above data, between 50-100ha of lowland acid grassland would appear to be the best estimate of its extent.

Conservation value

The upland fringe sites, in both ecological and land use terms, are best regarded as an integral part of the upland pastoral system that supports internationally important breeding wader populations. Otherwise, the truly lowland acid grasslands would appear to be of only local interest.

42.5 Future requirements for survey and conservation

Survey

The English Nature Local Team hopes to obtain a complete survey of the other two Districts of West Yorkshire. They also consider that the upland acid grassland fringes in the South Pennines in Greater Manchester and Lancashire require survey as a key priority because of their vulnerability to improvement and changes in agricultural practice, such as hay making to silage production. The survey of the lowland acid grassland of the two remaining Districts in West Yorkshire has a low priority at a national level. Survey of upland fringe grassland is best prioritised in terms of the impacts of the threats to the ecology and the pastoral system of the adjacent upland.

Conservation

There are no obvious national priorities for lowland acid grassland conservation in West Yorkshire.

42.6 References

LAVIN, J.C. & WILMORE, G.T.D. 1994. *The West Yorkshire plant atlas.* Bradford: Bradford Metropolitan Council.

RODWELL, J.S. 1994. The vegetation of West Yorkshire. *In*: J.C. LAVIN & G. T. D. WILMORE, eds. *The West Yorkshire plant atlas*, pp. 8-19. Bradford: Bradford Metropolitan Council.

Extract from Table 6 for West Yorkshire: occurrence of plant species generally faithful to lowland acid grassland

County: West Yorkshire	
Natural Area:	**24**
Chamaemelum nobile	0
Filago minima	1
Moenchia erecta	0
Ornithopus perpusillus	1
Teesdalia nudicaulis	0
Trifolium scabrum	1
Trifolium striatum	1
Total no. of species extant	4
Total no. of species extinct	3
Total no. of species recorded	7

24 =Coal Measures

1 = Recent record
0 = Apparently extinct

West Yorkshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1987-94	Field, Waste	Small fields in NA 24 and fringes of NA14	47	146.5	32.5	7.2		
Heathland Inventory		NI		Two woodland SSSIs	2	61.1			8.1	
Phase 2 Surveys		1993-96		Phase 2 surveys of Kirklees, Calderdale and Bradford				89.4		
Estimates, classes		1996		Colin Newlands, English Nature				B		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Phase 2 Survey	14.2							0.6				17.9										
Estimates, class	A					A		A				B						A				

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

43. Wiltshire

43.1 Physical

Geology

The centre and east of Wiltshire are dominated by the massive outcrop of Chalk, with Jurassic clays and limestones to the north west. There are only very limited outcrops of acidic rocks, with a small area of Tertiary deposits of the Hampshire Basin in the far south, and patches of Lower Greensand below the Chalk scarp, either side of Calne and by Swindon.

Soils

Soil associations dominated by strongly acid or freely draining acidic soils are also very restricted, with podzolic soils occurring in small areas of the Tertiary deposits in the south and on the Lower Greensand west of Calne. Otherwise acid soils are likely to be largely confined to areas of brown earths developed on clay with flints, and on the drift capping some of the chalk plateaux, although these sorts are likely to be fairly damp. They are most extensive in the Savernake Forest area (**Map 1b**).

43.2 Landscape history

19th Century

In the early 19th century, extensive unenclosed commons existed on the Tertiary deposits to the south which would have been similar to the commons of the New Forest. On the Lower Greensand south west of Calne, there was a small heathy common. There were also heathlands south of Longleat.

Current landscapes and Natural Areas

The Chalk outcrop is occupied by the South Wessex Downs Natural Area (NA80), Berkshire and Marlborough Downs Natural Area (NA79) and a small part of the Hampshire Downs (NA78).

The South Wessex Downs includes an area of podzolic soils developed on an out-lying outcrop of Tertiary deposits south east of Salisbury (SU2027), but the common land here has been long enclosed and replaced with farmland and plantation. The Berkshire and Marlborough Downs includes Savernake Forest where relic acid grasslands survive in pasture woodland glades, on drift over the Chalk.

To the south of the County a small part of the New Forest Natural Area (NA71) occurs within Wiltshire and, for the most part, is on London Clay. It has much in common with the South Coastal Plain and Hampshire Lowlands Natural Area (NA75). However, to the south on more acid Tertiary deposits, the extensive Hamptworth and Làndford Commons are enclosed with little semi-natural grassland left.

To the north west, Wiltshire is dominated by the Thames and Avon Vales Natural Area (NA63) and the Cotswolds Natural Area (NA55) where acid soils are rare or absent. The Thames and Avon Vale Natural Area is interrupted by the Midvale Ridge Natural Area (NA64). The Corallian limestones here are locally overlain by Upper Greensand which gives rise to small patches of acid soils. These are all in intensively farmed areas.

A small area of the Wessex Vales Natural Area (NA83) occupies the south west corner of the county. The heathlands that once occurred in this area have long gone.

43.3 Existing information

Flora

The coincidence maps (**Maps 2-4**) of lowland acid grassland species listed in **Table 1** show that the very high concentration found around the New Forest once extended into south Wiltshire, but these species have suffered a recent and serious decline. Otherwise, the rest of Wiltshire is poor in acid grassland species, although the Greensand outcrops on the Midvale Ridge can just be picked out.

The recent Wiltshire Flora (Gillam, 1993) records an impoverished acid grassland flora as would be expected in a county where acid soils are rare. Common acid grassland species are only local in the county. *Galium saxatile* is frequent only in the Savernake Forest area and the fringe of the New Forest but is scattered elsewhere, indicating small pockets of acid soil. *Rumex acetosella* is also local and several quite standard acid grassland species such as *Aira praecox* and *Plantago coronopus* are rare.

The characteristic lowland acid grassland recorded from the two Natural Areas in the north of the county with the highest concentrations of acid grasslands are listed in **Table 6** (relevant data extracted below). *Crassula tillaea* has also been recorded from the far west of the county but not recently.

Six of the other lowland acid grassland also appear to be extinct including *Filago minima*, *Hypochaeris glabra* and *Teesdalia nudicaulis* (**Table 6**). These were all recorded from ST96 (Perring & Walters, 1976 & Stewart et al, 1994), the area containing the largest Greensand outcrop at Spye Park. Another four species recorded from the south Wiltshire vice county recently are actually confined to grazed heathland within modern Hampshire. Only two acid grassland species, *Ornithopus perpusillus* and *Trifolium striatum*, have recently been recorded from the modern county of Wiltshire and these are rare. The flora picks out four areas which appear to support a surviving acid grassland flora:

- Spye Park (Tetrad ST9466): rabbit grazed, unimproved, turf on sandy soil on Lower Greensand with *Ornithopus perpusillus*, *Aphanes inexspectata* , *Plantago coronopus*, *Aira praecox* and *Vulpia bromoides*.
- Freeth Farm (Tetrad SU0272): an old sand pit on Upper Greensand with *Ornithopus perpusillus*, *Trifolium striatum*, *T. micranthum* and *Vulpia bromoides*.
- Okus Swindon (Tetrad SU1482): short turf, presumably on Upper Greensand, with *Trifolium striatum*.
- Savernake Forest (Tetrad SU26): several acid grassland species including *Ornithopus perpusillus*, *Nardus stricta*, *Trifolium micranthum*, *Aira praecox* and *Ulex minor*.

More limited acid grassland may occur at Fyfield Down NNR on drift over chalk. Here *Aira praecox* and *Aphanes inexspectata* are recorded. However, the grassland could be little more than some fragmentary parched acid grassland (U1) on anthills in grassland. No sites are mentioned within the New Forest Natural Area in modern Wiltshire and *Agrostis curtisii* is described as occurring mainly as relic populations on banks in reclaimed heathland.

Habitat surveys

In the Wiltshire County Grassland Inventory, acid grassland is noted only for the 904ha Savernake Forest SSSI (SU26), along with calcicolous and neutral grassland. No areas are given for the acid grassland.

A grassland survey concentrating on Wiltshire in general and the New Forest fringe of Hampshire in 1988 (Slade, 1988) recorded 1.8ha of semi-improved acid grassland near Landford (SU2617). This was recorded as U4 by Neil Sanderson and Lorna Slade but *Rumex acetosella* was present and it could equally have been described as U1e.

Survey of unimproved mesotrophic grassland and mire (Wilson 1995)

In 1995, a Phase 2 survey of the New Forest fringe in Wiltshire and the Vale of Wardour recorded some small areas of acid grassland. In the New Forest fringe, 0.6ha of U1f was recorded with H2c heath and a further 0.52ha of indeterminate acid grassland also recorded. In the Wiltshire fringes of the New Forest, the large areas of enclosed heathland have been reduced to improved farmland and forestry and the extensive areas of relic heath with acid grassland that exist in partially improved enclosed heathland in Hampshire are absent. A mown woodland glade in the Hamptworth Estate also supported a small area of U4, very similar to the pasture woodland glades of the New Forest. The Strip-winged Grasshopper *Stenobothrus lineatus*, was recorded from the glade in Hamptworth Estate and the owner claims New Forest Cicada *Cicadetta montana* also occurs here. This is conceivable as the glade is identical in structure to hundreds of glades in the New Forest pasture woodlands where it could also occur.

In the Vale of Wardour a single field with 2.24ha of U4b was recorded. This stand lacks *Festuca ovina* and has much bracken and tends towards U20b. *Rumex acetosella* is also noted as abundant so at least some of it is likely to be U1e.

Wiltshire Wildlife Trust Surveys

A Wiltshire Wildlife Trust survey of a a young, replanted, Forest Enterprise plantation adjacent to Spye Park outside the SSSI found areas of regenerating acid grassland with several species rare at a county level including *Plantago coronopus* and *Ornithopus perspusillus*. A second Wiltshire Wildlife Trust survey of a meadow at Emmett Hill (SU009) recorded a grassland which is intermediate between MG5c and U4, with locally frequent *Rumex acetosella* indicating a tendency to U1 as well.

Summary of consultations with Local Team Conservation Officers

Acid grassland is of limited extent in Wiltshire. It must have once been widespread in the south of the county, in the New Forest Natural Area, but this former heathland has been thoroughly enclosed and only tiny fragments of heath and acid grassland remains. Fragmentary U1f and U4 have been recorded and tiny patches of U3 may exist. Spye Park SSSI (in the Thames and Avon Vales Natural Area) is probably the best area for dry acid grassland species but there may be a possibility that parched acid grassland (probably U1b) here may have been omitted from the SSSI. Savernake Forest is a relic pasture woodland complex of great interest, with derelict U1e grasslands invaded by *Arrhenatherum* adjacent to CG2 communities in valley bottom glades. The grasslands here are in very poor condition and difficult to mow due to the presence of anthills. The Forest requires the restoration of extensive grazing and experiments are proposed to further this aim. Elsewhere there are a few areas of acid grasslands. It is possible that U1 grassland containing declining species survives in Longleat Park.

43.4 Summary of resource

Extent and composition

There is likely to be less than 50ha of acid grassland in Wiltshire with species-rich parched acid grassland (U1) restricted in extent and probably largely confined to the Midvale Ridge and the New Forest fringe.

Conservation value

None of the acid grasslands of Wiltshire are likely to be of national significance but some are clearly of great importance for maintaining the biodiversity of the county.

43.5 Future requirements for survey and conservation

Survey

The is a need to survey the remaining parched acid grasslands of the Midvale Ridge.

Conservation

The restoration of grazing to Savernake Forest and promotion of acid grassland restoration in the Calne area would be the two main priorities for acid grassland conservation in Wiltshire, outside the New Forest Natural Area. In the latter Area there are clear opportunities for heathland and acid grassland restoration in the areas of enclosed former heathland.

43.6 References

GILLAM, B. 1993. *The Wiltshire flora.* Oxford: Pisces Publications.

SLADE, L. 1989. *Neutral to acid grassland survey 1998-1990 (South Region): Interim report.* Newbury: Nature Conservancy Council, South Region.

WILSON, P.J. 1995. *Survey of unimproved mesotrophic grassland, mire and related habitats in the Wiltshire New Forest fringes and the Vale of Wardour. A summary and overview.* A report to English Nature.

Extract from Table 6 for Wiltshire: occurrence of plant species generally faithful to lowland acid grassland

County: Wiltshire		
Natural Area:	**64**	**79**
Chamaemelum nobile		0
Filago minima	0	
Hypochaeris glabra	0	
Moenchia erecta		0
Ornithopus perpusillus	1	1
Teesdalia nudicaulis	0	
Trifolium scabrum		0
Trifolium striatum	1	
Total no. of species extant	2	1
Total no. of species extinct	3	3
Total no. of species recorded	5	4

64 = Midvale Ridge
79 = Berkshire and Marlborough Downs

1 = Recent record
0 = Apparently extinct

Wiltshire acid grassland surveys

Survey Name	GR	Date	Landscape Types	Comments	No Sites	Site Area	Gr Area	AG Area	H Area	LHA
Grassland Inventory		1988	Pasture Woodland	Only Savernake Forest recorded	1	904	NI	NI		
Heathland Inventory		1986-95	Enclosure relic, Pasture Woodland	Dry heath confined to New & Savernake Forests	17	3283.0			6.9	
Wiltshire 1988		1988	Enclosure relic	Phase 2 survey (Slade,1988)	1			1.8		
New Forest 1995		1995	Enclosure relic	Phase 2 survey (Wilson, 1995)	3			1.4		
Vale of Wardour 1995		1995	Field	Phase 2 survey (Wilson, 1995)	1			2.2		
Estimates		1996		Neil Sanderson, EPR				A		

Survey Name	U1	U1a	U1b	U1c	U1d	U1e	U1f	U2	U2a	U2b	U3	U4	U4a	U4b	U4c	U4d	U4e	U5	U6	SD10	SD11	U20r
Grassland Inv.																						
Heathland Inv.																						
Wilts 1998	1.8					1.8																
New Forest	0.6						0.6					0.3										
Wardour 1995												2.2		2.2								
Estimates, class	A		?			A	A				?	A		A								

Key

Column headings
GR = Grid reference if relevant
No Sites = Number of sites
Site Area = Area of sites
GR Area = Area of grassland
A G Area = Area of acid grassland
H Area = Area of dry heath
LHA = Area of lichen heath
NI = No information
NA = Natural Area
U1-U20r = NVC communities/sub-communities

Area estimates
A = Less than 50 ha
B = 50-100 ha
C = 100-500 ha
D = 500-1,000 ha,
E = 1,000-5,000 ha
F = 5,000-10,000 ha
G = Greater than 10,000 ha
+ = Present but no area given
? = Possibly present

Appendix 1. Information used for describing the acid grassland resource for each county

Physical

Geology: a brief account of the geology.
Soils: a description of the soil associations found within the county.

Landscape history

19th Century: a brief description of the extent of unenclosed rough grazings in the early 19th century. The reprints of the old series, 1 inch, Ordnance maps (Harley and O'Donoghue 1975) were consulted for this data. These are the earliest versions of the 1 inch maps available.

Current Landscapes & Natural Areas: a description of the current landscape with reference to English Nature's Natural Areas (**Map 15**). The descriptions of the grassland resource for each of these Natural Areas given in Jefferson (1996) were found to be helpful (reference in Volume I).

Existing Information

Flora: Information on the acid grassland flora of the county from the Biological Records Centre is presented along with information gained from county floras. Special reference is made to the species generally faithful to acid grassland listed in **Table 1**. Species recorded from selected Natural Areas and counties, where information permitted, are listed in **Table 6** and the relevant extract from **Table 6** is given at the end of each county account.

Fauna: any information known to the contractor on the fauna of lowland acid grasslands of the county.

Habitat Surveys: information given by habitat surveys.

Results of Consultation: a summary of the information gained by consultation with EN Local Team staff and others. A list of all those consulted is given in **Appendix 3**.

Summary of Resource

Extent and composition: an assessment of the extent and composition of the lowland acid grassland resource in the county.

Conservation value: an initial assessment of the conservation value of acid grassland in the county.

Future requirements for survey and conservation

Survey: an assessment of the future requirements for lowland acid grassland survey in the county.

Conservation: an assessment of the future requirements for action to ensure the conservation of lowland acid grassland in the county.

References

HARLEY, J.B. AND O'DONOGHUE, Y. 1975. The Old Series Ordnance Survey maps of England and Wales (scale 1 inch to 1 mile). Lympne: Harry Margary.

Appendix 2. Fields used in the compilation of county spreadsheets

Survey Name

GR: grid reference, used for single site surveys.

Date of Survey

Landscape: landscape/habitat type in which the acid grassland is present. The following terms are used:

Heathland/heath: mosaics of acid grassland and ericaceous dwarf shrub vegetation.

Grass heath: grass dominated heathland, including Breckland acid and calcicolous grassland complexes.

Enclosure relic: fragment surviving as an obvious relic from enclosure of heathland or common.

Parkland: in landscape or deer park.

Calcicolous/drift: associated with patches of acid soil within chalk or limestone grassland landscapes

Field: in enclosed landscapes, often with neutral grassland or fen meadow

Common: common land sometimes dominated by neutral grassland or fen meadow

Pasture woodland: glades in pasture woodland.

Flood plain: on raised areas within floodplains.

Grazing marsh: shingle and banks within coastal grazing marsh.

Shingle: the non-maritime parts of shingle beaches.

Rock: hard rock outcrops.

Waste: industrial waste land, mine spoil heaps, quarries etc.

Coastal cliff: non-maritime acid grassland in coastal cliff top habitats

Comments: comments on features of specific interest, sources of information.

Site Area: area of whole site if known.

Gr Area: area of grassland if known. In some surveys this includes heath in mosaics with acid grassland.

AG Area: area of acid grassland if known.

H Area:	area of dry heath if known. Mainly used for data from the Heathland Inventory. Most dry heath is likely to have at least some acid grassland associated with it.
LHA:	area of lichen heath if known. Mainly used for data from the Heathland Inventory. Can include lichen-dominated acid grassland (U1a).
U1-U20r:	Areas of NVC communities or sub-communities if known, or '+' if present or '?' as possibly present. (U20r is a species-rich variant of U20, see Volume I, Chapter 2).

The areas are also entered as estimates using the following classes:

A: up to 50ha.

B: 50-100ha.

C: 100ha-500ha.

D: 500-1,000ha.

E: 1,000-5,000ha.

F: 5,000ha-10, 000ha.

G: more than 10,000ha.

Appendix 3. List of consultees according to county

Avon: Basil Greenwood (English Nature)
Bedfordshire: Tim Barfield (English Nature)
Berkshire: Graham Steven & Ted Green (English Nature)
Buckinghamshire: Graham Steven (English Nature)
Cambridgeshire: Donna Radley (English Nature) and Chris Gardner (EN site manager of Castor Hanglands NNR)
Cheshire: Chris Walker (English Nature)
Cornwall: Jon Stewart & Simon Leach (English Nature)
Cumbria: Ian Slater (English Nature)
Derbyshire: Ian Taylor (English Nature)
Devon: Rob Wolton (English Nature) was consulted on acid grassland in general and Simon Leach (English Nature) on coastal cliff grassland
Dorset: Jonathan Cox (English Nature) and Brian Edwards (Dorset Environmental Records Centre).
Essex: Stephen Ayliffe (English Nature)
Gloucestershire: Mike Wilkinson (English Nature)
Greater London: Stephen Ayliffe (English Nature) and Dr Francis Rose
Greater Manchester: Selina Hill (English Nature)
Hampshire: Diana Westerhoff (English Nature), Paul Edgar (Hampshire Heathland Project)
Hereford & Worcester: Mike Wilkinson (English Nature) in consultation with other Local Team members
Hertfordshire: Stephen Ayliffe (English Nature)
Humberside: Colin Newlands (English Nature)
Isle of Wight: Dr Colin Pope (Isle of Wight Council)
Kent: Richard Collingridge and Rob Cameron (English Nature) and Dr Francis Rose
Lancashire: Jon Hickling (English Nature)
Leicestershire: Ian Butterfield (English Nature)
Lincolnshire: John Shackles (English Nature), Mark Crick (Lincolnshire Wildlife Trust), Tim Smith (Ecological Services Ltd) and Clive Chatters (Hampshire Wildlife Trust)
Merseyside: Selina Hill (English Nature), Christine Bennett, Joint Countryside Advisory Service, Peter Gateley, vice-county recorder (v.c.59), Dr Hilary Ash
Norfolk: Claire Warnsbury (English Nature) and Dr Francis Rose
Northamptonshire: Max Coleman (English Nature)
North East England: Stuart Hedley (English Nature)
North Yorkshire: Dave Clayden in consultation with other members of the North and East Yorkshire Team (English Nature)
Nottinghamshire: Ian Butterfield (English Nature)
Oxfordshire: Graham Steven (English Nature)
Shropshire: Chris Walker (English Nature)
Somerset: Flemming Ulf-Hansen and Mike Edgington (English Nature)
South Yorkshire: Colin Newlands in consultation with other members of the Humber to Pennines Team (English Nature)
Staffordshire: Chris Walker (English Nature)
Suffolk: Anne Brenchley and Nick Sibbett (English Nature)
Surrey: Peter Tinning (English Nature) and Dr Francis Rose
Sussex: Peter Tinning (English Nature) and Dr Francis Rose
Warwickshire: Chris Walker (English Nature)
West Midlands: Chris Walker (English Nature)
West Yorkshire: Colin Newlands in consultation with other members of the Humber to Pennines Local Team (English Nature)
Wiltshire: Claire Lambert (English Nature) and Paul Darby (Wiltshire Wildlife Trust)

Appendix 4. Questionnaire sent to Local Team Conservation Officers for each county

1.
   a. What is your estimate/best guess for the extent of lowland acid grassland in your Team's area? You may like to use the following categories: 0-50ha, 50-100ha, 500-1000ha, 1000-5000ha, over 10,000ha (estimate amount).

   b. Can you estimate amounts of different NVC communities, U1 to U4, or put them in order of likely amounts?

   c. How is the grassland distributed (e.g. patchily/uniformly) and can you define this in terms of Natural Areas or parts of Natural Areas.

2. From your local knowledge, what is the conservation significance and the characteristics of sites with acid grassland i.e.. in terms of their landscape position (e.g. river bluffs, mosaic with heath, parkland etc.), NVC types, or other characteristics such as soils, special fauna and flora, and management?

3.
   a. Are there other (recent) surveys available apart from those we know about from doing the Grassland Inventories for your area? County Trusts might also have relevant information and if so, the name of a contact person would be helpful.

   b. Which Natural Areas/parts of Natural Areas would you see as priorities for further Phase 2 survey, with the principal aim of targeting incentive scheme payments?

4. Some examples of sites we might use to illustrate the types and characteristics of lowland acid grassland already have data (e.g. Breckland). Are there types of acid grassland in your area that could be surveyed at Phase 2 level next year to provide other illustrations, particularly with regard to their landscape position? Perhaps a maximum of 1 or 2 sites might be selected in your area, depending on the returns from all teams.